The Northeast – Southeast – Midwest Corridor Marketing Study

EXAMINING THE POTENTIAL TO DIVERT HIGHWAY TRAFFIC FROM INTERSTATE 81 TO RAIL INTERMODAL MOVEMENT

Final Report

Prepared for the

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THE NORTHEAST – SOUTHEAST – MIDWEST CORRIDOR MARKETING STUDY

EXECUTIVE SUMMARY

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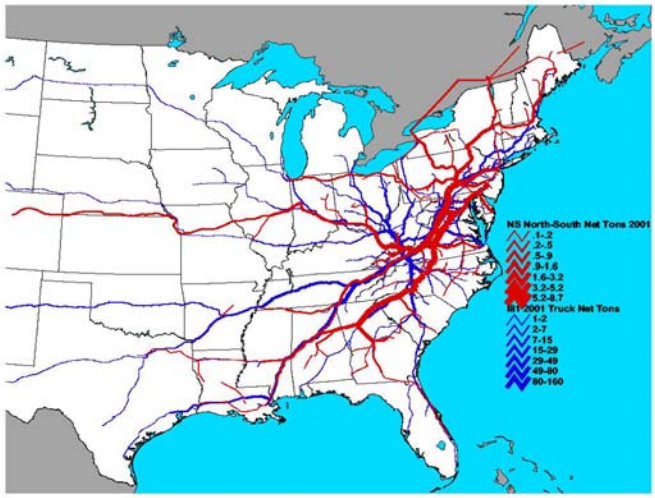
1. Introduction

Two Commonwealth-sponsored studies prior to this report analyzed the relationship between highway freight traffic and rail intermodal service in Virginia, along a north-south corridor focused particularly on Interstate 81. Rail intermodal is a cooperative service where trucks pick up and deliver their shipments, but the truck trailer (or container) is carried between cities by rail, thus reducing the number of trucks that have to travel by highway. The two studies were motivated by rising projections of highway congestion, by truck traffic growth exceeding what the highways were designed to handle, and by the perceived concern for safety among citizens whose automobiles share the road with commercial vehicles.

The collective analysis contained in these studies suggested that the opportunity to divert heavy truck traffic to rail intermodal would provide significant positive benefits to the Commonwealth. However, such a diversion could not be accomplished without substantial corridor-wide investments in the parallel rail infrastructure. A closer look was warranted and with federal funds to partially underwrite it, the Virginia Department of Rail and Public Transportation, commissioned the Northeast – Southeast – Midwest Corridor Marketing Study (the Study). Its purpose was to determine whether the Commonwealth should change the current calculus by injecting public capital into the development of competitive rail intermodal service for the I-81 corridor. Specifically, the Study sought to determine (1) is there a marketplace demand for improved intermodal service in the corridor; (2) what type of service offering will generate the greatest diversion benefit to the corridor; and (3) what level of public investment in rail intermodal will materially impact the level of highway commercial traffic for I-81?

Figure 1

Rail and Truck Flows: I-81 Corridor



2. Issues, Limitations & Risks

On Interstate Highway 81 at most times of day, about every third vehicle is a truck, and this is about double what the road was designed for. Motorists who share the road with commercial trucks often will feel unsafe and blame the larger vehicles for their concern, even when the trucks are carefully driven. A common solution for motorists is to try to separate themselves from trucks by passing or changing lanes; another way to accomplish the same purpose is to use the innate separation of the railroad system to carry truck freight. The Virginia Legislature recognized the concerns of its citizens in SJR-55 when it cited safety as a primary reason to shift highway freight to rail, and indicated that possibility should be examined in the studies that culminated in this report.

The Legislature also recognized that freight traffic crosses state boundaries, and that individual pieces – like particular highway corridors within Virginia – are interdependent parts of a larger network. Traffic shifts in the Commonwealth of Virginia will be created by investments and actions in other states, and investments made by the Commonwealth will produce benefits for others as well as for itself. The resolution HJR-704 called for cooperation with other states to produce a network of rail intermodal facilities, in order to reduce heavy truck traffic on Virginia highways.

The initiatives envisioned by the Legislature necessarily face a series of issues, limitations and risks. The prominent ones concern coalitions, capital cost, public benefits, local resistance, the addressable market, and carrier performance:

- *Coalitions:* Other states may be unable or unwilling to make or support railroad investments. This report therefore considers two levels of public involvement:
  - Corridor-wide, where multi-state coalitions work in partnership with Virginia and the railroads to make network investments, and public capital is applied to infrastructure from New York to New Orleans. This produces a higher volume of traffic diversions;
  - Virginia-based, where the Commonwealth makes rail investments inside its borders, while its railroad partners act both outside and within the state. This produces a lower volume of traffic diversions.

Two investment alternatives are considered in this analysis:

- Corridor-wide strategy
- Virginia-based strategy

In practice, Virginia-based investments can be the forerunners of a corridor-wide program, and in fact, the capital requirements for Virginia rise in the corridor-wide plan because it accumulates more volume over time. It is also true that a multi-state coalition may be formed with several but not all states of the corridor

participating. Rail programs in these states today range from minor to large, yet the scope of the I-81 initiative breaks new ground.

- *Capital Cost:* Willing partners may be unable to finance the investments called for in this report, or may finance them incompletely. This is important because a corridor infrastructure program covers hundreds of miles and costs a great deal of money: from hundreds of millions of dollars in Virginia, to billions of dollars corridor-wide. Federal funding possibly can offer an alternative, but that too may be unavailable or insufficient. Although capital investments often have to be made in a series of whole steps (because half measures get less than half the results), in general less funding will lead to fewer traffic diversions.

- *Public Benefits:* Related to costs are benefits, of course. While this Study was commissioned to measure the volume but not the benefits of highway traffic diversions to rail, there are some obvious payoffs for the public: road congestion generally will be lower, motorists will feel safer, and there will be more capacity to deliver business and consumer goods. There are associated benefits as well, which include:

    - Reduced highway user costs and avoided highway investments;
    - Improved transportation fuel efficiency and lower environmental emissions;
    - Greater competitiveness for U.S. industry through gains in logistics productivity;
    - Transportation network redundancy, which is an aid to national security and emergency response.

- *Local Resistance:* Freight traffic taken from the highways means more freight trains moving on the rails. Citizens in the sections of Virginia that could see train growth may find it unwelcome, and their resistance could leave the trucks on the road. Likewise, local businesses that depend on high-volume truck activity (such as truck stops or fueling stations) might see their commercial opportunities diminished as a result of reduced highway growth rates. This report recommends investments in what promise to be the most practical rail routes. However, as with many public decisions, there are trade-offs to be debated and weighed.

- *Addressable Market:* A significant portion of truck traffic can never use rail intermodal service, because the shipments don't travel far enough, or they have to move too fast, or they don't go where the railroad is, or they would cost too much

to travel another way. However, there is also a significant portion of truck traffic that rail could handle, but has not adequately addressed. This report looks to a newer generation of railroad equipment in order to make intermodal service appeal to as much of the truck business as possible, and to more of the truck business than usual. The effect is that the *percentage* of trucks in the I-81 traffic stream can be reduced by rail diversion, yet the sheer *number* of trucks in the corridor will continue to grow.

- *Carrier Performance:* Equality of service between intermodal and highway transportation is called for by customers and developed in this Study. It must be produced by railroads and sustained through the years it will take to build diverted volume. If the service is compromised, diversions will drop. The Commonwealth therefore will want performance commitments from its rail partners to back up its investments. Conversely, highway travel time is projected by Virginia DOT to worsen with congestion in the coming years. This slows down truck service and acts as a mild stimulus to traffic diversions. This Study assumes no major corrective investment will be made to improve truck service on the roads. On the other hand, it also assumes that no highway tolls will be imposed that might encourage the use of rail.

3. The Northeast – Southeast – Midwest Corridor Marketing Study

Four primary tasks comprised the Study: (1) conduct of surveys and interviews with shippers and network motor carriers, to determine the level of marketplace interest in and performance criteria for competitive rail intermodal service in the corridors; (2) investigation of service design alternatives to identify the right combination of rail intermodal product, cost, and performance features for the demands of the marketplace; (3) performance of detailed diversion analysis to determine the rate, magnitude, and composition of projected modal shifts accruing to the introduction of an improved intermodal service; and (4) definition of the level and location of capital investment required to support the projected modal shift.

3.1 Shipper and Carrier Interviews and Surveys

Primary market research was conducted among the freight users of the Commonwealth highway corridors. Users fell into two general categories: shippers whose goods travel in Virginia on their way to market, and the motor and rail carriers who serve such shippers. The results of this analysis are consistent with national trends and portray both shippers and carriers as willing to shift traffic to rail intermodal if their cost and service demands are routinely satisfied.

The research reveals marketplace demands that current rail intermodal service offerings do not provide. These include (1) a rail intermodal technology that is less restrictive to the current mix of highway trailers; (2) a single-driver[1] truck competitive service that includes frequent service departures and 95-98% on-time delivery, door to door; and (3) a significant economic incentive to offset the added complexity and coordination of rail intermodal operations.

While current CSX and NS intermodal operations seek to provide these features, motor carriers and shippers alike indicated that current product offerings routinely fall far short of this benchmark.

3.2 Service Design and Diversion Analysis

The key dynamic in the traffic diversion analysis conducted for this Study is public investment that allows the introduction of new intermodal services, raises their performance characteristics, and reduces the structural cost of railroading by moderating its capital intensity. The new services constitute a versatile and more effective product proposition that satisfies the needs of shippers by meeting the operating specifications of motor carriers. Traffic is won away to rail particularly by appealing to motor carriers to substitute intermodal for their "line-haul" intercity road operations. The appeal is persuasive because it offers fully equivalent performance at a significantly lower cost than the motor carriers can achieve on the highway, and it accommodates any trailer equipment in a standard truck fleet without modification or penalty.

Intermodal services are supposed to be based on compatibility between rail and highway transportation. However, many kinds of truck equipment can't be handled by traditional rail, and those it *can* handle often need special modification. This is a major flaw in conventional intermodal services, but it is eliminated by a newer generation of railcar. This railcar (already in regular use in Canada) employs an open style of technology that can carry almost any of the truck trailers moving on today's highways. This Study adopts this railcar to help establish real compatibility between railroads and trucking, and in so doing to increase the size of the addressable market for intermodal. Motor carriers acting in partnership with rail ultimately can reduce their cost of operation without special investment or sacrifice in performance, and shippers can receive the service they seek while improving on its economy. These factors combine to create a strong reason for traffic diversions.

Highway diversions in this Study are further aided by two network effects. First is the confluence of large volumes of through truck traffic in Virginia, where the national highway system is channeled between the mountains and the sea. This channeling causes traffic to concentrate into trainload quantities for sustained distances, which appropriate rail terminals and service design can exploit. Second, as its geographic scope, north-

south interconnection and service frequency expand, the rail intermodal network begins to duplicate the fleet balance economy motor carriers produce over the road, enabling these carriers to retain their efficiency as their rail use grows.

The series of influences that public investment initiates - service improvement, capacity and system expansion, equipment availability, and lower cost-to-market – were incorporated in a quantitative process to project traffic diversions in the I-81 corridor. Its estimation techniques were based on detailed competitive analysis and patterns of historical preference that have been successfully tested in previous freight studies over the last decade. The diversion results mirror the representations of shippers and carriers who operate in the corridor: that service parity coupled with strong cost reductions generates meaningful mode shifts.

3.3 Required Capital Investment

Capital investments in the rail corridor are required to improve service speed and terminal access to render rail offerings competitive, and to expand capacity in order to handle additional traffic as it is diverted. The proposed improvements are designed to fulfill the product strategy, and to support the full volume of rail traffic projected in the long-range diversion analyses. They include multiple tracks and passing sidings that work like additional lanes on highways, signaling systems that raise the frequency and speed at which trains can be safely run, and the construction of larger and new intermodal terminals to transfer loads between highway and rail. Improvements are to be made potentially on both NS and CSX rights-of-way, in Virginia and other states.

The states included in the corridor-wide analysis represent those impacted by the current and future I-81 congestion, and/or those deriving off-corridor benefits through the conversion of highway traffic to rail intermodal. Those states include Texas, Louisiana, Mississippi, Alabama, Tennessee, Georgia, North Carolina, South Carolina, Virginia, West Virginia, Maryland, Pennsylvania, and New Jersey.

4. Results of the Study

The results of market research and detailed competitive analysis completed for this Study suggest that public investment in rail intermodal infrastructure can produce material relief for highway traffic in the I-81 corridor, and that this impact can be made to occur in a practical time frame.

4.1 Corridor-Wide Results

An initial, medium-term investment between $2.6 and $2.8 billion across the corridor, produces highway diversions between 670,000 and 720,000 annual truck loads over three to five years, after construction. One out of seven trucks is removed from I-81 in

Virginia, and the percentage of trucks in its traffic stream drops from every third vehicle to every fourth. The Virginia portion of this initial investment is $540 to $590 million.

Over another ten to twelve years, a cumulative investment between $7.3 and $7.9 billion builds highway diversions to a range of 2.8 to 3.0 million truck loads annually. Two out of seven trucks are removed from I-81 in Virginia, and the percentage of trucks in its traffic stream holds steady at 25%, despite strong commercial growth. The Virginia portion of the total long- term investment is $1.3 to $1.4 billion. Viewed incrementally, the additional dollars after the initial investment are approximately $5 billion corridor-wide, and $800 million in Virginia.

The set of corridor-wide investment and diversion results are summarized in Tables 1 through 4. Low and high scenarios are presented as ranges for public investment, over medium and long term time horizons. The tables distinguish the major activity on the Norfolk Southern (NS) lines that parallel I-81, from the lesser activity on CSX lines. The term AADTT refers to Average Annual Daily Truck Traffic, and is used here to measure the rate of truck diversion from the Virginia sections of the highway. The term VMT refers to Vehicle Miles Traveled, and is a measure of the reduced truck usage of the highway.

4.2 Virginia-Based Results

A medium-term public investment of approximately $500 million in Virginia alone, produces highway diversions between 470,000 and 500,000 annual truck loads over five to seven years, after construction and across the corridor. Diversions from the Virginia-based investment take longer to fully mature (five to seven years, versus three to five years in the initial Corridor-Wide program) because the investments are lower and more restricted, and thus makes their influence less strong. Three elements – the network effects of Virginia investments, improvements Norfolk Southern will make inside and outside the Commonwealth with other funds, and the fact that so much truck travel begins and/or ends beyond its boundaries - cause the Virginia-based program to create diversions in multiple states. In the Commonwealth itself, one out of ten trucks is removed from I-81, and the percentage of trucks in the I-81 traffic stream drops from every third vehicle to approximately every fourth.

Local resistance to this program is apt be less, because train volumes will be lighter. However, no additional, long-term diversions are produced from Virginia-based investment, for two reasons. First, all of the programmed capital is expended in the medium term; more funds to support the continuing build-up of diversions are assumed to be unavailable. Second and relatedly, the Norfolk Southern system reaches capacity once medium-term diversions are achieved, and it cannot absorb more traffic without investments in other states. The consequence is that freight traffic on the highway will

continue to grow along with the economy, but rail traffic cannot grow. Over another eight to ten years, and based on Virginia DOT forecasts, the proportion of trucks that rail has been able to remove from I-81 becomes one out of twenty (because rail numbers stay the same while highway numbers get bigger), and the percentage of trucks in the highway traffic stream climbs back to one out of three. This result can be viewed to say that Virginia-based investments work best as a first step toward a corridor-wide program. It can also be viewed to say that Virginia may undertake what it can, but no single state has broad influence over its patterns of traffic.

The set of Virginia-based investment and diversion results are summarized in Tables 5 and 6. Low and high scenarios again are presented as ranges for public investment, and the effects are shown for the medium and long-term time horizons.

4.3 Implications

The proposed investments successfully reduce highway volumes because they help deliver a reformed railroad product offering. The product relies upon: (1) a flexible or "open" intermodal technology that accommodates highway trailers of essentially all types; (2) intermodal service that is fully competitive with single-driver truck performance over the road; and (3) a compelling economic advantage produced through public-private cost sharing. In this configuration, the core of the domestic truck business – the standard highway trailer – is addressed with an intermodal product that is not an inferior good, and with an economy that many motor carriers and shippers will feel they can't walk away from in a competitive market. Public capital is used to concentrate rail investment in a single corridor through the Commonwealth of Virginia where it might not otherwise be focused, and to a degree that it yields visible benefits for citizens. Thousands of heavy trucks per day can be diverted to a naturally separated rail route, leaving motorists feeling safer and the highways less congested.

The traffic diversions produced in this Study are material and the long-range, corridor-wide projections may appear dramatic, but they are by no means unprecedented for mature intermodal lanes. Similar intermodal traffic participation is seen today in comparable lanes elsewhere in the country, where high levels of rail service have been offered for sustained periods of time. In addition, the relatively large number of through trucks channeled through I-81 in Virginia makes diversions in the Virginia sections correspondingly large. A roadway with a higher percentage of local traffic would offer fewer opportunities. Finally, the competitive outcomes expected by this Study really are a normal business result: genuinely good and accessible service from a low cost provider usually wins customers. The factors that will most matter to achieving these results are the procurement of financing and perhaps multi-state cooperation, the organization of citizen support, and the long-term performance of the railroads.

The Commonwealth has favored a multi-modal approach to freight transportation, in this context meaning that it believes highway and rail options both are essential. This Study supports that approach. In an environment of significant freight traffic growth on Virginia highways, the long-range, corridor-wide diversions and investments succeed in absorbing about 60% of the additional truck volume forecast for I-81 by VDOT, and the Virginia-based program absorbs just 10%. In the medium term, there is an absolute reduction in the number of trucks from today's levels, but ultimately the number of trucks will grow under *both* investment scenarios – and meanwhile, automobile activity is steadily rising, too. Consequently, while rail initiatives provide very substantial capacity for the movement of freight, *highway expenditure continues to be necessary*.

5. Conclusions and Recommendations

This Study demonstrates that public investment in rail intermodal infrastructure can produce material relief for highway needs in a practical timeframe. These results are supported by the market research and detailed competitive analysis that comprise this Study. A capital program based inside Virginia could win a moderate amount of highway relief, or greater relief could be sought with a corridor-wide, multi-state program. The financing requirements are challenging in either case, and financing is not the only issue. Moreover, the scope of the corridor-wide plan is such that it can be compared to large, interstate highway initiatives, but it has no parallels in recent public rail investment. Even so, this is precisely the kind of rail program that the American Association of State Highway Transportation Officials (AASHTO) called for, when they said, "states and railroads must make (their) partnership extend beyond state boundaries, and set priorities for network-level investments. The need today is to treat the key elements of the national (rail) network – nationally significant corridors, intermodal terminals, and connectors."[ii]

Virginia can choose not to act, but the situation for its citizens on heavily traveled roadways will worsen, and the freight system will be slowed. It can choose to act alone, but the construction it undertakes inside the Commonwealth produces a shared benefit, because it reduces highway volumes for its neighbors. And, with 70% of its truck traffic beginning or ending travel outside Commonwealth borders, Virginia and a number of other states are interdependent for freight service. Interdependence and shared benefits constitute a clear argument for coordinated, multi-state action and contribution.

States face limited options for the provision of capacity, railroads face limited capital and prospects for growth, motor carriers seek lower costs of effective operation to satisfy their customers, and motorists want peace of mind as they drive. For all of these parties, the intermodal initiatives explored in this Study can be part of the solution. They offer no

solution unless the challenges of coalition, financing, and public support can be faced and answered, but the effort to face them is plainly worthwhile.

Table 1 – Corridor-Wide Investment

Projected Medium and Long-Term Diversion Impacts - NS Corridors

Medium Term Annual Impact	Annual Loads Diverted Total Corridor[iii]	Percent of VA I-81 AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario[iv]			
Low	670,000	13.7%	179.6
High	720,000	14.6%	190.5

Long Term Annual Impact	Annual Loads Diverted Total Corridor	Percent of VA I-81 Forecast AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario			
Low	2,790,000	28.2%	759.1
High	3,000,000	30.3%	811.9

Assumptions:

1. Adequate capital financing and multi-state cooperation can be procured.
2. Local resistance does not preclude growth in rail traffic.
3. An "Open" Intermodal technology will be employed in the study corridors.
4. Railroads will offer and maintain competitive service performance in the study corridors.
5. Railroads will offer compelling cost reductions (vis-à-vis highway transport) to shippers and/or carriers currently operating on the study corridors as an offset to public investment.
6. The available infrastructure can be configured to accommodate the identified traffic growth.
7. Historical patterns of intermodal market penetration are an appropriate measure of projected penetration for lanes of similar density and distance.
8. The VDOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.
9. Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.

Table 2 – Corridor-Wide Investment

Medium and Long-Term Capital Needs Assessment – Total for NS Corridors

Medium Term Investment	Capacity and Speed Improvements	Terminal Expansion and Construction	Rolling Stock Acquisition	Total
Public Investment Scenario	(Millions)	(Millions)	(Millions)	(Millions)
Low	$1,974	$339	$337	$2,649
High	$2,153	$339	$354	$2,846

Long Term Investment	Capacity and Speed Improvements	Terminal Expansion and Construction	Rolling Stock Acquisition	Total
Public Investment Scenario	(Millions)	(Millions)	(Millions)	(Millions)
Low	$5,841	$507	$985	$7,333
High	$6,372	$507	$1,020	$7,899

Assumptions:

1. Adequate capital financing and multi-state cooperation can be procured.
2. Investments levels projected above provide capacity for diverted volumes plus organic growth of between 20% and 30%.

Table 3 – Corridor-Wide Investment

Projected Medium and Long-Term Diversion Impacts – CSX Corridor

Medium Term Annual Impact	Annual Loads Diverted Total Corridor	Percent of VA I-81 AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario			
Low	170,000	0.2%	1.9
High	180,000	0.2%	2.4

Long Term Annual Impact	Annual Loads Diverted Total Corridor	Percent of VA I-81 Forecast AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario			
Low	620,000	0.4%	7.9
High	700,000	0.4%	8.8

Assumptions:

1. Adequate capital financing and multi-state cooperation can be procured. No improvements specific to CSX facilities and track structure were projected.
2. Local resistance does not preclude growth in rail traffic.
3. An "Open" Intermodal technology will be employed in the study corridors.
4. Railroads will offer and maintain competitive service performance in the study corridors.
5. Railroads will offer compelling cost reductions (vis-à-vis highway transport) to shippers and/or carriers currently operating on the study corridors as an offset to public investment.
6. The available infrastructure can be configured to accommodate the identified traffic growth.
7. Historical patterns of intermodal market penetration are an appropriate measure of projected penetration for lanes of similar density and distance.
8. The VDOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.
9. Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.

Table 4 – Corridor-Wide Investment

Medium and Long-Term Capital Needs Assessment -- Virginia Portion of Corridor-Wide Improvements

Medium Term Investment	Capacity and Speed Improvements	Terminal Expansion and Construction	Rolling Stock Acquisition	Total
Public Investment Scenario	(Millions)	(Millions)	(Millions)	(Millions)
Low	$432	$40	$72	$544
High	$472	$40	$76	$588

Long Term Investment	Capacity and Speed Improvements	Terminal Expansion and Construction	Rolling Stock Acquisition	Total
Public Investment Scenario	(Millions)	(Millions)	(Millions)	(Millions)
Low	$1,001	$40	$212	$1,253
High	$1,091	$40	$219	$1,350

Assumptions:

1. Adequate capital financing and multi-state cooperation can be procured.
2. Investments levels projected above provide capacity for diverted volumes plus organic growth of between 20% and 30%.
3. Virginia contribution to rolling stock is based on proportional contribution to overall corridor improvements.

Table 5 – Virginia-Based Investment

Projected Medium and Long-Term Diversion Impacts - NS Corridors

Medium Term Annual Impact	Annual Loads Diverted Total Corridor	Percent of VA I-81 AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario			
Low	474,000	9.8%	132.7
High	501,000	10.4%	143.5

Long Term Annual Impact	Annual Loads Diverted Total Corridor	Percent of VA I-81 Forecast AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario			
Low	474,000	4.9%	132.7
High	501,000	5.2%	143.5

Assumptions:

1. Adequate capital financing can be procured.
2. Local resistance does not preclude growth in rail traffic.
3. An "Open" Intermodal technology will be employed in the study corridors.
4. Railroads will offer and maintain competitive service performance in the study corridors.
5. Railroads will offer compelling cost reductions (vis-à-vis highway transport) to shippers and/or carriers currently operating on the study corridors as an offset to public investment.
6. The available infrastructure can be configured to accommodate the identified traffic growth.
7. Historical patterns of intermodal market penetration are an appropriate measure of projected penetration for lanes of similar density and distance.
8. The VDOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.
9. Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.

Table 6 – Virginia-Based Investment

Medium Term Capital Needs Assessment - Total For NS Corridors

Medium Term Investment	Capacity and Speed Improvements	Terminal Expansion and Construction	Rolling Stock Acquisition	Total
Public Investment Scenario	(Millions)	(Millions)	(Millions)	(Millions)
Low	$242	$21	$229	$492
High	$242	$21	$238	$501

Long Term Investment	Capacity and Speed Improvements	Terminal Expansion and Construction	Rolling Stock Acquisition	Total
Public Investment Scenario	(Millions)	(Millions)	(Millions)	(Millions)
Low	N/A	N/A	N/A	N/A
High	N/A	N/A	N/A	N/A

Assumptions:

1. Limited network of terminals including Meridian, MS; Huntsville, AL; Atlanta, GA; Knoxville, TN; Alexandria, VA; Harrisburg, PA; Philadelphia, PA; and Elizabeth, NJ.
2. Additional right of way improvements in West Virginia and Maryland would be financed by Norfolk Southern (perhaps in conjunction with other public sector sources), as would terminal construction in Mississippi, Georgia, Tennessee, Pennsylvania and New Jersey. These costs are estimated to be $23 Million and $130 Million respectively.
3. Capacity limitations on NS rail network, and expected traffic growth in carload segments preclude any significant volume of diversions in excess of those stated above, more so over a longer analysis period.

THE NORTHEAST – SOUTHEAST – MIDWEST CORRIDOR MARKETING STUDY

FINAL REPORT

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1. Introduction

Railroad and motor carriage networks are parallel, interdependent and overlapping operating systems designed to respond efficiently to the market needs of their freight customers. But while motor carriers traverse a publicly provided network to facilitate high-service freight operations, railroads are burdened with the cost of building and maintaining an expensive but efficient private right-of-way. Not surprisingly, the private sector system of resource allocation that seeks to satisfy owners is often incongruent with public sector priorities and public benefits. With increased highway congestion and safety issues looming for the region's transportation arteries, the Virginia Legislature recognized that a vigorous effort by all parties – both private and public – would be required to develop practical and efficient solutions to congestion challenges of the future. To examine this more closely, the Virginia Department of Rail and Public Transportation utilized federal funds to commission the Northeast – Southeast – Midwest Corridor Marketing Study (Study). Its purpose was to determine whether the Commonwealth should change the current economic calculus by injecting public capital into the development of competitive rail intermodal service for the I-81 corridor.

Figure 1

Highway Traffic on I-81

2. Situation in the Corridor

As it has served in the history of our nation, so Virginia is a linchpin of transportation, linking the enormous consumer markets in the Northeast with the fast growing manufacturing economies of the Southeast, Southwest and Mexico. This role is played out daily through the massive movements of freight over four major North-South highway and railroad corridors. Crossing the Commonwealth are two of the most heavily traveled Interstate Highways,

I-81 and I-95, and the main rail lines of Norfolk Southern and CSX. These routes move in excess of 450 million tons annually, comprising some 3.2% of the total freight movements in the nation, and more than 7% of long-haul[v] freight.

But for Virginia, serving as a conduit of the Nation's North-South trade activity is not without cost. Over 42% of the truck traffic moving in the state represents "through-traffic", neither originating nor terminating in the Commonwealth. Roads such as I-81 and I-95 are among the most heavily traveled in the nation, and the expense of maintenance and expansion along these routes is immense. The future prospects of congestion relief are bleak, as recent Federal Highway Administration Forecasts suggest a 90%[vi] increase in truck traffic on these routes between 1998 and 2020.

Figure 2

Distribution of All Virginia 2001 Truck Volume (indexed from 1998)

Direction	Net Tons	Loads	Share of Tons	Share of Loads
Inbound	46,706,967	2,181,137	12%	12%
Outbound	72,631,711	3,371,287	19%	19%
Local	103,226,134	5,161,745	27%	29%
Through	158,834,286	7,126,188	42%	40%
Total	381,399,098	17,840,357	100%	100%

The primary mode for the North-South movement of goods and services in the region is truck. The vehicles range from long tractor-trailers hauling food from warehouses to high-volume grocers, to smaller, heavily laden dump trucks en-route to job sites, to light route trucks and step vans making twenty-five stops in a thirty-mile business pocket. They operate according to the schedules of their clientele, some in the late night and early morning, others throughout the workday. These trucks are the immediate conduits by which goods and services are supplied and distributed in the to economies up and down the Eastern Seaboard, supporting the indigenous population, businesses, institutions, and government.

Between Chicago, IL and New York, NY the intermodal share of the combined total truck and intermodal market is 25%, while for the similar distance Harrisburg, PA to Atlanta, GA lane, intermodal only gets 5.3% of the volume.

Historically, intermodal transportation has not been a strong competitor in flows between the U. S. North and Southeast. A number of factors have contributed to this circumstance, including a historical railroad bias towards long-haul east-west routes, and until recently, a relatively un-congested north-south freeway network. For example, between Chicago, IL and New York, NY the intermodal share of the combined total truck and intermodal market is 25%, while for the similar distance Harrisburg, PA to Atlanta, GA lane, intermodal only gets 5.3% of the volume.[vii]

With the forecast of significant traffic growth looming, and highway funding falling, the Virginia General Assembly (through House Joint Resolution 704 and Senate Joint Resolution 55) requested an analysis of alternative investments in intermodal facilities as a means of reducing the need for the massive highway expansion needed to accommodate the projected growth.

2.1 Prior Studies

To date, there have been two Commonwealth-sponsored studies to analyze the relationship between highway traffic and rail intermodal in Virginia. These are the Virginia Intermodal Feasibility Study conducted by Parsons Brinkerhoff, and the SJR-55 Study conducted by Wilbur Smith Associates and NS, one of the two major freight carriers serving the Commonwealth. The collective analysis contained in these studies suggested that the opportunity to divert long-haul truck traffic to rail intermodal would provide significant positive benefits to the Commonwealth. However, such a diversion could not be accomplished without substantial corridor-wide investment in the parallel rail infrastructure. Although these studies identified the general potential benefits to the Commonwealth of diverting long-haul traffic to rail, they failed to answer three critical questions:

1. Is there a marketplace demand for improved intermodal service in the corridors?
2. What type of service offering will generate the greatest diversion benefit to the corridor, and
3. What level of public investment in rail intermodal will materially impact the level of highway congestion for I-81?

These questions represent the focus of this Northeast – Southeast – Midwest Corridor Marketing Study.

3. The Northeast – Southeast – Midwest Corridor Marketing Study

The goal of this latest study has been to determine the marketplace demand for improved intermodal services, and the degree to which such services could divert highway traffic from the congested I-81 and I-95 corridors. The foundation of this Market Study is an overview of the current freight market environment. This data provides the origins and destinations of freight in Virginia, the quantity and commodity mix of that traffic, and the distribution of traffic between and within modes. Reebie's quantification of the potential shifts of freight traffic from highway to rail intermodal service is centered on an evaluation of specific individual traffic lanes (one origin linked to one destination). Current traffic flows were analyzed in detail; volume and commodity mix changes forecasted, and adjustments made for prospective highway congestion, and pending hours-of service (HOS) legislation. This assessment involves weighing competitive alternatives against the rail intermodal offerings brought to market by changes in rail operations.

In addition to the use of Reebie Associates analytic models for estimating the relative impact of cost, service, and technological alternatives, a series of surveys and interviews with shippers, motor and rail carriers provided substantial quantitative calibration, and qualitative support for the results.

The primary tasks completed for the Study included the following: (1) conduct surveys and interviews with shippers and network motor carriers to determine the level of marketplace interest in and performance criteria for competitive rail intermodal service in the corridors; (2) investigate service design alternatives to identify the optimal combination of rail intermodal product, price, and performance features for the demands of the marketplace; (3) perform a detailed diversion analysis to determine the rate, magnitude, and composition of projected modal shifts accruing to the introduction of an improved intermodal service in the I-81 and I-77 corridors, and (4) define the level and location of capital investment required to support the projected modal shift in the I-81 corridor.

The shippers contacted perceived that rail intermodal transportation in the corridor is generally less expensive than truck, but is also less reliable and provides longer transit times.

3.1 Shipper and Carrier Interviews and Surveys

Primary market research was conducted among the freight users of the Virginia highway corridors. Users fell into two general categories: shippers whose goods travel in Virginia

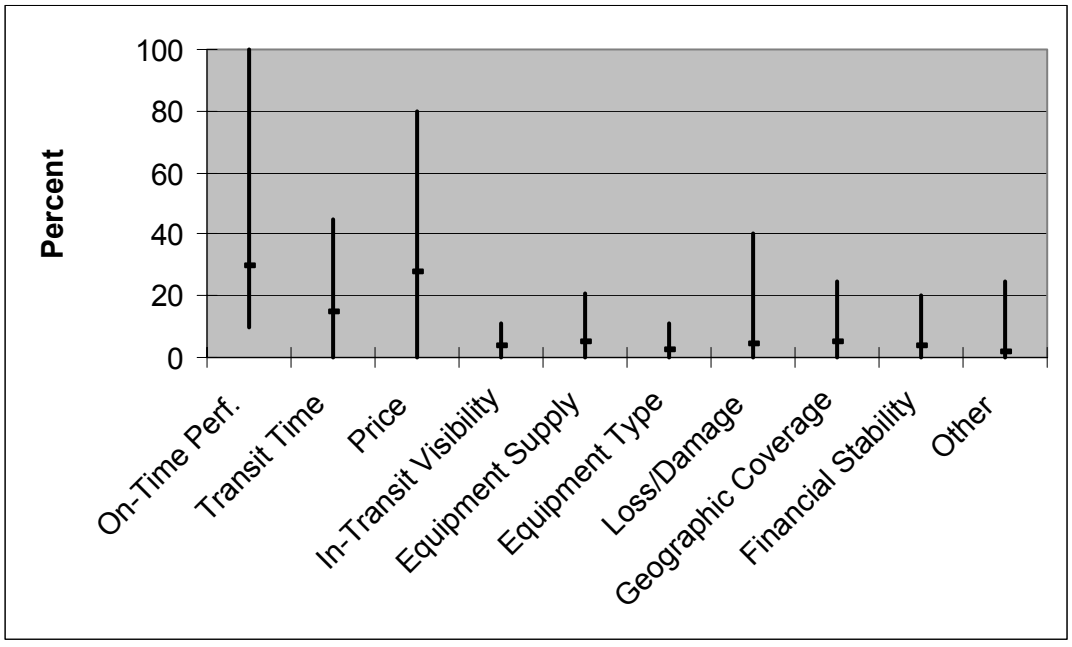
on their way to market, and the motor and rail carriers who serve such shippers. Each makes decisions that cause traffic to move by highway and could cause it to move by rail.

The results of this analysis mirror national trends in shipper and carrier behavior. Two-thirds (67%) of the shippers contacted rely entirely on trucking as their mode of transportation. The other third uses a mixture of rail carload, rail intermodal and trucking, with rail usage ranging from 20% to 90% depending on corridor, commodity, and company. The shippers contacted perceived that rail intermodal transportation in the corridor is generally less expensive than truck, but is also less reliable and provides longer transit times. Shippers also cited a myriad of other perceptual issues with rail intermodal such as "poor access", "increased loss and damage", and "only practical in lanes of greater than 1000 miles". These responses are outlined in Figure 3.

Figure 3

I-81 Shippers -- Freight Carrier Selection Criteria

(Vertical Bars Represent Range, Horizontal Dashes Represent Average Response)



The focus of our motor carrier research was among "Network" motor carriers, the primary consumers of rail intermodal service. These carriers can provide superior pickup and delivery service, due to the presence of operating assets in virtually all important market areas, and the high degree of control they exercise over them. They are intimately familiar with the cost/service trade-offs inherent to intermodal operation, and provide the load densities necessary to develop trainload volumes. In the study corridors, network carriers handled 28% of the movements[viii], while the balance of the identified traffic moved via smaller motor carriers. These other segments of the motor carrier industry expressed some exposure to rail intermodal services, but few routinely employ intermodal in their operations. Some carriers even snubbed intermodal to their shippers – citing their lack of intermodal participation as a marketing asset.

I-81 shippers currently prefer highway-based transport alternatives.

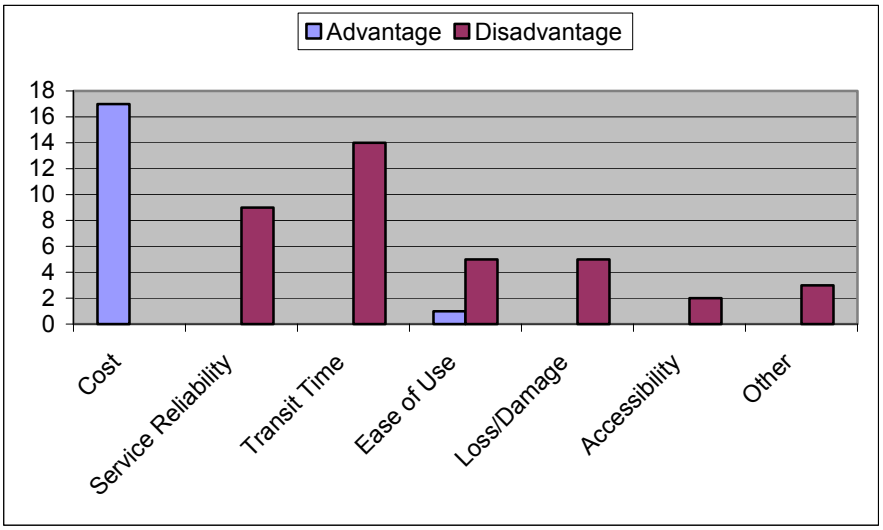
The marketplace demands of Network carriers is that rail intermodal service be competitive with the door-to-door transit times offered by a truck with a single driver. Whereas a single driver truck movement departs when the freight is ready and is delivered on appointment, intermodal train departures are scheduled at a time convenient for the preponderance of the traffic, not necessarily for the time benefit of any single load of freight. Thus service frequency is often as critical a factor in determining service parity as movement speed (See Figure 3).

In addition to service frequency, the service reliability demands for rail intermodal in the marketplace must support what truckers offer to their customers: 95-98% on-time (door-to-door) was the stated standard among the shippers and carriers interviewed. While CSX and NS ramp-to-ramp performance may approach this, carriers and shippers alike indicated that door-to-door transit times for rail intermodal movements today routinely fall far short of this benchmark. This perception leads among a host of issues that have caused I-81 shippers to prefer highway-based transport alternatives. (See Figure 4).

The railroad interviews provided that while both CSX and NS have been working aggressively to grow North-South traffic, several factors are currently limiting the rate of growth. These include terminal capacity, train capacity, line capacity, line geometry, empty equipment availability and interline cooperation. With flat economic growth over the past three years, both railroads have focused their limited resources upon the most profitable traffic available. In the competition for scarce railroad resources, the lower margin North-South TOFC services have had difficulty competing against long haul, high-margin, double-stack transcontinental container traffic.

Figure 4

Shipper Perceived Advantages and Disadvantages of Rail Intermodal



3.2 Required Product Service Features

The composition of freight traffic moving along the I-81 corridors is very diverse, and includes substantial volumes of traditional dry freight, as well as lesser volumes of bulk liquid, bulk solid, flatbed, automotive and livestock traffic. Current intermodal services generally appeal only to a limited cross section of available freight based on length of

haul, truck body type and construction, service tolerance and the relative size and scope of the participating motor carrier.

Current intermodal services generally appeal only to a limited cross section of available freight based on length of haul, truck body type and construction, service tolerance and the relative size and scope of the participating motor carrier.

Although the majority of the corridor volumes – 53% – represent dry-van freight (the type of traffic that is most competitive for intermodal transport), 47% of the freight is moving in tank, hopper, flat, automobile, and livestock trailers, and as such is currently difficult, if not impossible to convert to conventional rail intermodal technologies.

Equipment type and balance play a large role in a trucking company's intermodal decisions. Motor carriers operate a combination of equipment including spring-suspension (spring-ride) trailers, air suspension (air-ride) trailers, and intermodal containers. In order to be employed in rail intermodal service a trailer must be constructed or "equipped" to withstand the vertical lift on and off of the rail car. In general, rail intermodal movements require the use of spring-ride, lift bed or "reinforced" trailers. Such trailers represent only a small portion of the trailers on the road today. In fact, current estimates are that as few as 30% of trailers in service today on the I-81 corridor are rail intermodal compatible[ix].

Even when a motor carrier operates rail intermodal compatible equipment, the modal decision can also be impacted by equipment balance. If a motor carrier fleet has standardized with the type of trailer that can be lifted, then any load can be moved by truck or as an intermodal shipment. For these carriers, the choice of mode becomes independent of the equipment. For fleets that have mixed equipment composition, spring-ride, air-ride, and containers, the mode choice is not independent. The carrier must be sure that the equipment assigned to the move supports the mode choice of the subsequent loaded movement. Thus carriers will select conventional trailers to move over-the-road despite the availability of intermodal service so as to facilitate a subsequent over-the-road movement that requires conventional equipment.

Finally, the carrier's traffic density in the lane and his geographic scope impact the choice of intermodal versus over-the-road movement. Motor carriers with national scope and high corridor density are most likely to find advantage in intermodal movement than regional or small carriers. This is so for several reasons, including coordination of local drayage, opportunities for movement triangulation, and asset utilization. In the study corridors, only 28% of the movements were handled by "large" operators, while 14% were "mid-sized" and 58% were classified as "small"[x].

Whereas the large national carriers can coordinate the local pick-up and delivery of trailers at the intermodal terminal, most small and medium carriers do not maintain the geographically distributed operations required for rail intermodal use. Carriers such as J.B. Hunt and Schneider can support local operations in Atlanta, GA and Harrisburg, PA for local dray operation, but smaller carriers are unlikely to have a base of operations in both places that can support intermodal. While some carriers have developed service agreements with other operators to facilitate intermodal participation, such arrangements are rare. Thus small and medium sized trucking firms generally do not participate in rail intermodal movement, while large carriers seek to leverage rail intermodal to convert traffic from these "regionals" to themselves.

It is estimated that less than 30% of the highway trailers currently in service are compatible with conventional intermodal technologies.

Likewise, the larger carriers are better able to triangulate equipment *on* the intermodal network and thus produce greater operating efficiency than can small and medium size carriers, who rely on over-the road-triangulation to improve asset utilization.

Finally, larger carriers are able to utilize their regional lane density to improve asset utilization: trucks, trailers, and drivers are spend more time in loaded movement than can often be obtained by the small and medium-sized carriers that have only limited density in a given lane or region.

3.3 Intermodal Product Proposition

The rail intermodal product proposed by this study employs a mix of conventional and unconventional intermodal technology in order to address a wide range of untapped market segments. It stresses speed, frequency, and reliability so as to offer a product that is fully the equivalent of single driver, over-the road service, and not an inferior substitute. Its central focus is an appeal to network motor carriers, because of the belief that market penetration may be achieved more rapidly by this route, and because the door-to-door integrity of the product may be stronger and therefore more appealing to the region's shippers.

3.3.1 Technology

In the rail industry's struggle to develop a more "open" intermodal technology, both CSX and Norfolk Southern have been market leaders. CSX implemented the innovative Iron Highway in the 1980's, while Norfolk Southern launched RoadRailer service through its Triple Crown subsidiary. Both carriers have recognized that current Container-On-Flat-

Car and Trailer-On-Flat-Car (COFC/TOFC) equipment technology severely limits intermodal's market appeal by denying access to all but a limited population of trailers, and by requiring the separation of tractors, drivers, and trailers. For years, the industry has sought to develop a technology that is compatible for trailers of all types and sizes (including tractors and drivers as desired) to appeal to the over 70% of freight nationally that is not readily convertible to conventional rail intermodal.

While it is estimated that less than 30% of the highway trailers currently in service are compatible with conventional intermodal technologies, the trailer-based service product proposed for the I-81 service utilizes Expressway®-style technology: the versatility of which can accommodate without modification nearly every type of trailer that appears on the highway today. Without the adoption of a flexible and open intermodal technology, rail market penetration is severely constricted.

Figure 5

Canadian Pacific Expressway® TOFC Equipment

Photo Courtesy: David Graham (with permission)

The study team evaluated several different technology alternatives, and believes that a variation of Canadian Pacific's Expressway concept holds the most promise. This could also be combined with elements from the Rolling Highway operating in several locations in Europe, to provide for access to complete tractor-trailer units. While a production version of Rolling Highway technology does not currently exist for the North American market, the technological modifications to current production equipment should not be significant. The team believes that the development, and testing of prototypes within two years is reasonable, and that in the meantime, current technologies provide sufficient potential for diversion to warrant investment.

Historically, intermodal transportation has not been a strong competitor in flows between the U. S. North and Southeast.

The value of a more "open" intermodal technology is significant, in that it removes a capital investment requirement for truck lines to move their own equipment by rail, allows their fleets to remain uniform and retain the efficiency of interchangeability, and reduces (but does not eradicate) the costly problem of trailer imbalance. The rapidity and low cost of terminal transfers in Expressway-style service also make the product effective for the high volume, shorter

haul traffic, whose capture would raise the effectiveness of railway alternatives to road investments.

But while the lack of an open intermodal technology has helped limit the rate of rail intermodal growth to the composite growth rate of compatible equipment, load balance, and large carrier traffic conversion, two other factors have also limited intermodal traffic growth. These are competitive service, and the relative cost advantage of rail intermodal versus over-the-road truck.

3.3.2 Competitive Service

The marketplace demands that rail intermodal service be competitive with the door-to-door transit times offered by a truck with a single driver.

Historically, intermodal transportation has not been a strong competitor in flows between the U. S. North and Southeast. A number of factors have contributed to this circumstance, including a historical railroad bias towards long-haul and hence high revenue east-west routes, and a relatively uncongested north-south freeway network. With the acquisition of Conrail by Norfolk Southern and CSX, there is now a greater potential to profitably serve this market. At the same time, increasing congestion, longer hauls (including a strong growth in international traffic), as well as market concentration may also push logistics choice towards intermodal. But both rail carriers admit the struggle to serve these North-South markets profitably, and each operates only a handful of trains in the corridor.

While both CSX and NS are working aggressively to grow North-south traffic, several factors are currently limiting the rate of growth. These include terminal capacity, train capacity, line capacity, line geometry, empty equipment availability and interline cooperation. With the struggling U.S. Economy dampening profits, both railroads' strategy has been to focus the scarce resources of the company upon the most profitable traffic available: in the competition for scarce railroad resources, the lower margin North-South TOFC services have had difficulty competing against long haul, high-margin, transcontinental container traffic.

The marketplace demands that rail intermodal service be competitive with the door-to-door transit times offered by a truck with a single driver. Measuring rail intermodal transit times and service consistency however, is a complex task. In addition to the ramp-to-ramp transit time, drayage and terminal dwell time at both the origin and destination must be considered. In other words, a shipment must pick up, move to the origin ramp,

move by rail, be grounded at the destination ramp and delivered in the same time that would be required for a truck driven by a single driver to do it directly.

Whereas a single driver truck movement departs when the freight is ready, and is delivered on appointment, intermodal train departures are scheduled at a time convenient for the railroad, not necessarily for the benefit of any single load of freight. Thus service frequency is often as critical a factor in determining service parity as movement speed. For rail intermodal, the frequency of departures must be such that dwell time at the ramp is minimal *for every load*, otherwise the motor carriers' service commitments cannot be protected. While there is an obvious economic trade-off between departure frequency and operational efficiency, the current once-daily departures severely limit the ability of NS or CSX to divert significant highway volumes.

In addition to service frequency, the service reliability demands for rail intermodal in the marketplace must support what truckers offer to their customers: 95-98% on-time (door-to-door) was the stated standard among the shippers and carriers interviewed. While CSX and NS ramp-to-ramp performance may approach this, carriers and shippers alike indicated that door-to-door transit times for rail intermodal movements routinely fall far short of this benchmark.

For this project, various increases in both train frequency and train speed were analyzed in an effort to provide single-driver competitive transit times for the largest possible volume of the available traffic. Diversions driven by open intermodal technology and the compelling rail cost reductions achieved through cost sharing created the substantial volumes that improved train frequency, while speed performance improvements of between ten and thirty percent augmented forecast diversion results.

3.3.3 Compelling Cost reductions achieved through Public-Private "cost sharing"

The competitive nature of intermodal transportation is such that it is among the least profitable traffic on the railroad. The remarkable success of the railroads in reducing operating costs has been met nearly dollar-for-dollar by the trucking industry. As railroads distribute capital to those projects offering the most promising financial return, intermodal initiatives often go wanting. Add to that the untested nature of new technologies, and the relatively short-hauls in the study corridors, it is not difficult to understand why the sizeable capital investment required to affect substantial highway diversion in this region has not yet been made.

Like most facets of railroading, intermodal operations are extremely capital intensive. Terminals require paving, security, lighting, and tracking systems; rights-of-way require roadbed, signaling, and dispatching; while locomotives and rolling stock add

From the public sector perspective, capital investment is the vehicle to resolve regional transportation conflicts.

significant costs to the equation. The combined private sector capital costs of these items can be as much as one third of the railroads total expenses.

From the public sector perspective, capital investment is the vehicle to resolve regional transportation conflicts. And for the Commonwealth of Virginia, these numbers are huge: highway spending for 2000 was $2.7 billion. But Virginia, like many other states, recognizes the futility of trying to constantly build its way out of highway congestion.

The results of this study suggest that a public-private cost sharing program could help achieve the desired goal of reducing long-term highway congestion along I-81 and I-95 through investment in rail intermodal infrastructure. It is also apparent that such an investment could prove to be more cost effective than new highway construction.

The injection of public sector capital in the private sector changes the economic equation, and thus the priorities of the railroad. Absent the awesome burden of capital repayment, the railroad makes a high-priority of what would have otherwise been a low-priority opportunity.

The public sector capital costs necessary to support the new service over the long term are expected to be between $7.3 and $7.9 billion. These expenses would be phased to match the rate of modal conversion for the study routes. A more complete analysis of the estimated capital spending and the phasing of requirements is provided later in the report. Several mechanisms are available to affect the cost sharing contemplated in the analysis, many having been used successfully in other public-private partnership initiatives such as the Alameda Corridor project or the Virginia Inland Port.

In this analysis, we have simulated the injection of public sector capital through the effective reduction of the railroads' costs and subsequently, its price-to-market. Cost reductions of between 20% and 25% were analyzed to reflect the sharing of capital expense by the public sector, and would be utilized for the line upgrades, terminal construction, and equipment purchases required to support the proposed service.

The effect of these compelling adjustments is to place the cost of rail intermodal significantly below the operating cost of over-the-road trucking. Rational operators will likely find the rail-based product unavoidably economical, and elect to utilize rail intermodal in favor of all-highway transport in the corridor.

As the distance between the origin and the destination increases and lane volume grows, intermodal service becomes more competitive relative to highway, and its cost advantage increases.

3.4 Diversion Analysis

The key dynamic in the traffic diversion analysis conducted for this study is public investment that allows the introduction of *new* intermodal services, raises their performance characteristics and reduces their cost of operation.

The market research effort provided that the shipper and motor carrier communities would welcome the introduction of competitive intermodal service, as current offerings provide only once daily departures between a small subset of origin points. Diversion impacts were measured over the medium term (three to five years) and the long term (thirteen to seventeen years). As geographic scope and service frequency expand, the intermodal network begins to duplicate the fleet balance economy motor carriers now achieve only on the highway. Motor carriers' use of rail is likely to rise, and their cost competitiveness climb. The network carriers' new found cost leverage will attract business away from less efficient operators, or cause them to convert to intermodal.

These results can be further improved through the expansion of competitive intermodal services to other rail carriers such as CSX. While the needs assessment for such an expansion was not completed as a part of this analysis, the incremental diversion results were calculated, and are provided in Figure 8.

The great majority of motor freight travels only a short distance, and is thus not conducive to intermodal transportation. Likewise, many motor freight movements occur in volumes and at frequencies not generally appropriate for intermodal service. In the course of our analysis, we developed a series of tests to identify those lanes, which by virtue of their commodity, distance, density, geography and circuitry, would be positively impacted by hypothetical improvements in the rail intermodal rate and service calculus.

Intermodal market penetration is a function of two primary factors: (1) relative length of haul and (2) concentration of volume in traffic lanes. As the distance between the origin and the destination increases and lane volume (density) grows, intermodal service becomes more competitive relative to highway, and its cost advantage increases (See Figure 6). A statistical interpretation of this principle underlies the Reebie Associates' Diversion Model that was employed to estimate the diversion of traffic to rail intermodal for the selected corridors in the Virginia I-81 Corridor Analysis.

Reebie's quantification of the potential shifts of freight traffic from highway to rail intermodal service is centered on an evaluation of specific individual traffic lanes (one origin linked to one destination). The lanes were selected based on projections for improved intermodal service resulting from hypothetical investments in infrastructure, the volumes of highway traffic and the potential of such traffic to contribute to intermodal train volumes, and the likelihood that diversions would be successful.Our assessment of potential rail intermodal gains from these lanes employs a series of tools

Figure 6

Truck vs. Rail Intermodal Market Share for Dry-Van Commodities

Based on Lane Density and Distance

Relative Length of Haul	Lane Density (Thousands of Annual Tons) by Intermodal and Dry Van					
	< 100		100 - 400		> 400	
	IMX	Truck	IMX	Truck	IMX	Truck
1 - 99	0%	100%	0%	100%	0%	100%
100 - 299	0%	100%	1%	99%	1%	99%
300 - 499	1%	99%	2%	98%	3%	97%
500 - 699	1%	99%	6%	94%	9%	91%
700 - 999	2%	98%	8%	92%	23%	77%
1000 - 1499	3%	97%	7%	93%	23%	77%
> 1500	6%	94%	22%	78%	65%	35%

Source: Reebie TRANSEARCH 1998; BEA to BEA Flows

and techniques, developed by Reebie Associates and used in ICC and STB proceedings to assess the potential traffic gains from rail network investment. This assessment involves weighing competitive alternatives against the rail intermodal offerings brought to market by changes in rail operating cost. In particular, we determined the relative changes in modal shares that would result from the changes in costs and service arising from the benefits of proposed investments on a lane-by-lane basis.

We examined current modal shares and then correlated those to the underlying changes in the rail carriers' estimated operating costs. We also examined service competition to assure that the new intermodal service offering would meet or exceed market standards.

Recognizing that rail-truck intermodal traffic increasingly operates between hub centers (usually located in or near major metropolitan areas), our study methodology took into account the fact that intermodal facilities located in some cities could economically be used to reach other metropolitan markets outside of those immediate areas, even some distance from the terminal. Such a long "reach" requires the use of an extended dray, but this is not uncommon, particularly as part of a long rail line-haul movement.

3.4.1 Issues, Limitations & Risks

Substantive shifting of I-81 corridor traffic to rail is a major undertaking, involving large-scale investments and necessarily facing a series of issues, limitations and risks. The key ones concern coalitions, capital cost, local resistance, the addressable market, and carrier performance:

- *Coalitions:* I-81 and its feeders span a dozen states, but other states in the corridor may be unable or unwilling to make or support railroad investments. This report therefore considers two levels of public involvement, and divides its diversion results accordingly:

    - Corridor-wide, where multi-state coalitions work in partnership with Virginia and the railroads to make network investments, and public capital is applied to infrastructure from New York to New Orleans. This produces a higher volume of traffic diversions;

    - Virginia-based, where the Commonwealth takes independent action to invest in rail inside its borders, while its railroad partners act both outside and within the state. This produces a lower volume of traffic diversions.

    In practice, Virginia-based investments can be the forerunners of a corridor-wide program, and in fact, the capital requirements for Virginia rise in the corridor-wide plan because it accumulates more volume over time. It is also true that a multi-state coalition may be formed with several but not all states of the corridor participating. Rail programs in these states today range from minor to large, yet the scope of the I-81 initiative breaks new ground for all of them.

- *Capital Cost:* Willing partners may be unable to finance the investments called for in this report, or may finance them incompletely. This is important because a corridor infrastructure program covers hundreds of miles and costs a great deal of money: from hundreds of millions of dollars in Virginia, to billions of dollars corridor-wide. Federal funding possibly can offer an alternative, but that too may be unavailable or insufficient. Capital investments often have to be made in a step function, where some threshold amount is required for the next step and

where half measures get less than half the results. In general, however, less funding will lead to fewer traffic diversions.

- *Local Resistance:* Freight traffic taken from the highways means more freight trains moving on the rails. Citizens in the sections of Virginia that could see train growth may find it unwelcome in their neighborhood, and their resistance could mean that trucks stay on the road. Likewise, local businesses that depend on high-volume truck activity (such as truck stops or fueling stations) might see their commercial opportunities diminished as a result of reduced highway growth rates. This report recommends investments in what promise to be the most practical rail routes. However, as with many public decisions, there are trade-offs to be debated and weighed.

- *Addressable Market:* A significant portion of truck traffic can never use rail intermodal service, because their shipment distance is too short, or their transit requirement is too fast, or the shipment doesn't go where the railroad is, or the cost is too high to travel another way. However, there is also a significant portion of truck traffic that rail could handle, but has not adequately addressed. This report looks to a newer generation of railroad equipment in order to make intermodal service appeal to as much of the truck business as possible, and to more of the truck business than usual. The effect is that the *percentage* of trucks in the I-81 traffic stream can be reduced by rail diversion, yet the sheer *number* of trucks in the corridor will continue to grow.

- *Carrier Performance:* Service parity between intermodal and highway transportation is called for by customers and developed in this Study. It must be produced by railroads, and they must sustain it through the years that it takes to build diverted volume. If the service is compromised, diversions will drop. The Commonwealth therefore will want performance commitments from its rail partners to back up its investments. Conversely, highway travel time is projected by Virginia DOT to worsen with congestion in the coming years. This slows down truck service and has a mild, positive effect on traffic diversions. This Study assumes no major corrective investment will be made to improve truck service on the roads. On the other hand, the Study also assumes that no highway tolls will be imposed on I-81; the introduction of truck tolls would induce additional diversions to rail.

3.4.2 Corridor-Wide Diversion Results

Corridor-wide traffic diversions are driven by capital improvements to infrastructure, particularly through the upgrading of right-of-way, the acquisition of more versatile

intermodal equipment, and the expansion or new development of terminals. This investment spawns the service improvement, capacity expansion, equipment availability, and ultimately the lower price-to-market that stimulates the significant traffic diversions. Low and high cost sharing scenarios evaluated the impact of 20% and 25% market price savings, respectively[xi]. The medium and long-term results of these analyses for NS lines appear in Figure 7, while similar results for CSX lines appear in Figure 8.

Figure 7 – Corridor-Wide Investment

Projected Medium and Long-Term Diversion Impacts - NS Corridors

Medium Term Annual Impact	Annual Loads Diverted Total Corridor	Percent of VA I-81 AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario[1]			
Low	670,000	13.7%	179.6
High	720,000	14.6%	190.5

Long Term Annual Impact	Annual Loads Diverted Total Corridor	Percent of VA I-81 Forecast AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario			
Low	2,790,000	28.2%	759.1
High	3,000,000	30.3%	811.9

Assumptions:

1. Adequate capital financing and multi-state cooperation can be procured.
2. Local resistance does not preclude growth in rail traffic.
3. An "Open" Intermodal technology will be employed in the study corridors.
4. Railroads will offer and maintain competitive service performance in the study corridors.
5. Railroads will offer compelling cost reductions (vis-à-vis highway transport) to shippers and/or carriers currently operating on the study corridors as an offset to public investment.
6. The available infrastructure can be configured to accommodate the identified traffic growth.
7. Historical patterns of intermodal market penetration are an appropriate measure of projected penetration for lanes of similar density and distance.
8. The VDOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.
9. Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.

Figure 8 – Corridor-Wide Investment

Projected Medium and Long-Term Diversion Impacts – CSX Corridor

Medium Term Annual Impact	Annual Loads Diverted Total Corridor	Percent of VA I-81 AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario			
Low	170,000	0.2%	1.9
High	180,000	0.2%	2.4

Long Term Annual Impact	Diverted Total Corridor Annual Loads	Percent of VA I-81 Forecast AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario			
Low	620,000	0.4%	7.9
High	700,000	0.4%	8.8

Assumptions:

1. Adequate capital financing can be procured.
2. Local resistance does not preclude growth in rail traffic.
3. An "Open" Intermodal technology will be employed in the study corridors.
4. Railroads will offer and maintain competitive service performance in the study corridors.
5. Railroads will offer compelling cost reductions (vis-à-vis highway transport) to shippers and/or carriers currently operating on the study corridors as an offset to public investment.
6. The available infrastructure can be configured to accommodate the identified traffic growth.
7. Historical patterns of intermodal market penetration are an appropriate measure of projected penetration for lanes of similar density and distance.
8. The VDOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.
9. Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.

With the completion of the preliminary diversion analyses for both NS and CSX, the decision was made to focus the substantial efforts of developing a detailed needs assessment on the NS lines, as they provided the promise of greater diversion potential for the congested I-81 corridor. The CSX diversion results produced in this analysis

provide the basis for a follow-on needs assessment for their route that parallels I-95 along the Eastern Seaboard.

3.4.2.1 Sensitivity Analysis

In addition to these factors, the diversion analysis considered several other items for their impact on the diversion results. These included recent changes in Federal Hours of Service (HOS) regulations, truck service delay resulting from increased highway congestion (reduced highway Level of Service or "LOS"), and the impact of average train speed performance.

3.4.2.2 Hours of Service and Level of Service Factors

While the HOS and congestion delay factors were static adjustments, train speeds were advanced in increments from thirty miles per hour (MPH) through forty-two miles per hour to evaluate the impact of service performance (and the associated capital requirements) on the diversion results. These results suggested that incremental adjustments to train speed provide some, but limited benefit in terms of diversion impact. The faster transit times impact shorter-haul traffic lanes disproportionately in that rail intermodal service – with only modest train speed performance improvements – can be competitive for most long-haul freight.

The principal factors in facilitating modal conversion are truck service competitiveness and economic inducement.

In addition, the adjustments for the recently revised Federal Hours of Service regulations, and truck service delay resulting from increased highway congestion (decreasing level of service, LOS), provided some but not significant impact on overall diversions. The collective impact of these adjustments was less than 6% overall. The results of these combined analyses appear in Figure 9.

The principal factors in facilitating modal conversion are truck service competitiveness and economic inducement.

Figure 9

Annual Diversion as a Function of

Investment, HOS, LOS and Average Train Speed

Annual Loads Diverted	Average Train Speed (MPH)				
Public Investment Scenario	30	33	36	40	42
Low	2,710,000	2,790,000	2,830,000	2,900,000	2,910,000
High	2,920,000	3,000,000	3,040,000	3,110,000	3,120,000

Assumptions:

1. Adequate capital financing can be procured.
2. Local resistance does not preclude growth in rail traffic.
3. An "Open" Intermodal technology will be employed in the study corridors.
4. Railroads will offer and maintain competitive service performance in the study corridors.
5. Railroads will offer compelling cost reductions (vis-à-vis highway transport) to shippers and/or carriers currently operating on the study corridors as an offset to public investment.
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8. The VDOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.
9. Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.

3.4.2.3 Mean Confidence Interval of Reebie Associates Diversion Model

The statistical mean confidence interval for the diversion model is 95%. This produces a 95% likelihood that the expected rail intermodal market share performance will fall between 1.9 million units (low end of confidence interval based on low investment case), and 3.1 million units (high end of confidence interval based on high investment case), assuming that prospective intermodal market shares will mirror historical patterns. As

intermodal market shares in existing lanes are growing, very likely the actual performance results will be higher than projected.

3.4.2.4 Length of Haul Performance

It has long been accepted that intermodal traffic is most competitive in longer lengths of haul – primarily those over 700 miles. Intermodal participation is less than 3% for all dry van shipments of less than 500 miles, and is negligible for local movements. In lanes of less than 500 miles, conventional intermodal products are generally not considered competitive. Reebie has however, conducted several analyses that suggest that intermodal can be competitive in shorter lengths of haul, given an appropriate set of circumstances. These circumstances can include (1) the circuity of the combined drayage and rail line-haul versus the available highway alternative, and, (2) the density of the corridor (as measured by tons or truckloads of divertible freight). In circumstances where rail intermodal circuity is low, and where lane density is high, railroads have been successful in carving out niches of traffic in corridors of less-than 500 miles. Canadian Pacific's Expressway model is offering competitive service between Toronto and Montreal – a distance of 540 miles, and between Toronto and Detroit – a distance of 380 miles. These short distances suggest that under some circumstances, rail intermodal services can be competitive in short haul lanes. For this analysis, we analyzed traffic moving on the study corridors over distances greater than 350 miles.

Figure 10

Corridor-Wide Investments: Long Term Diversion Results

Mileage breakdown of High Investment Case

HIGHWAY MILES			
From	To	TRANSEARCH 2020 Diverted Annual Loads	TRANSEARCH 2020 Percent of Loads Diverted
350	499	21,531	3.2%
500	699	447,633	17.7%
700	999	902,386	32.7%
1,000	1,499	840,589	29.4%
1,500	1,999	672,134	34.8%
2,000	3,100	112,917	31.3%
Total		2,997,190	

Assumptions:

1. Adequate capital financing can be procured.
2. Local resistance does not preclude growth in rail traffic.
3. An "Open" Intermodal technology will be employed in the study corridors.
4. Railroads will offer and maintain competitive service performance in the study corridors.
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8. The VDOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.
9. Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.

The diversion results in this analysis reinforced the perceptions of the shippers and carriers operating in the corridor: that despite the favorable market conditions present in the corridor and the availability of an improved service alternative, the mileage

thresholds of intermodal penetration can be reduced but not eliminated. This is evident in the summary (Figure 10) which points out that the proposed service still cannot effectively infiltrate the under 500 mile overnight and local service markets, as the time penalty of pickup and delivery operations undermines gains in line haul speed and service consistency.

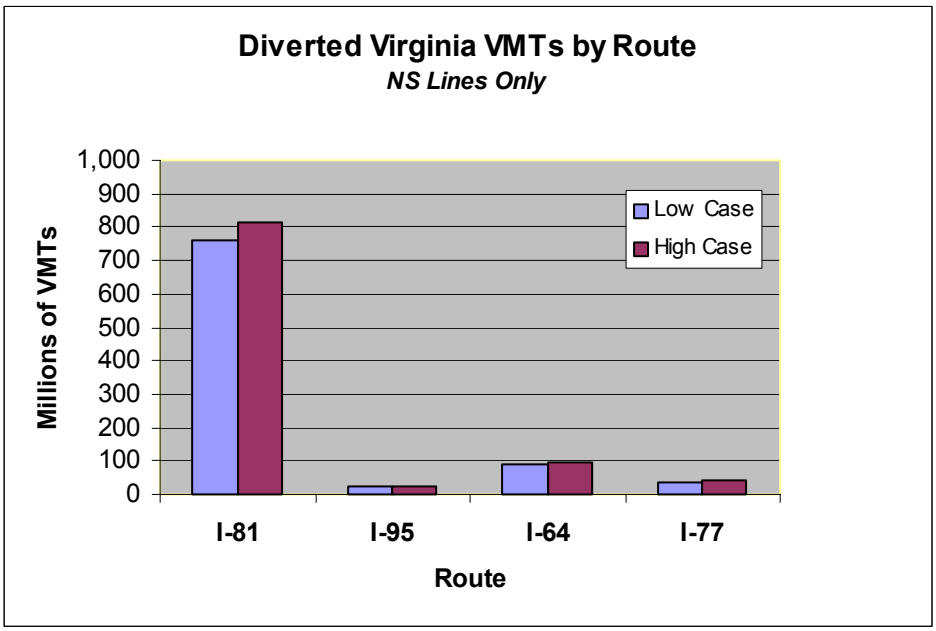
3.4.2.5 Secondary Benefits

In addition to the primary benefit of congestion relief, the diversion of highway traffic to rail intermodal offers a number of secondary but related benefits. These benefits were not quantified in this Market Study, but would be expected to include:

- Reduced highway user costs and avoided highway investments;
- Improved fuel efficiency and lower emissions;
- Strengthened industrial competitiveness; and
- Network redundancy for national security and emergency response.

Figure 11

VMT Impact of Diversions from Corridor-Wide Investments in NS Lines



Assumptions:

1. Adequate capital financing can be procured.
2. Local resistance does not preclude growth in rail traffic.
3. An "Open" Intermodal technology will be employed in the study corridors.
4. Railroads will offer and maintain competitive service performance in the study corridors.
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8. The VDOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.
9. Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.

The analytical evaluation of these benefits would generally hinge upon a quantification of changes in Vehicle Miles Traveled (VMT). This calculation represents the number of diverted units multiplied by the miles traveled on the corridor. Inasmuch as this analysis

was to evaluate the collateral impacts of diversions on the areas other highway corridors, we calculated the impact of the diversions – in terms of reduced VMT – for the region's major arteries. The results of this analysis for the Corridor-wide NS scenario appears in Figure 11.

3.4.3 Virginia-Based Diversion Results (Independent Action)

Through SJR-55 and HR-704, the Virginia Legislature recognized the need for corridor-wide cooperation to reduce congestion, and this study validates that multi-jurisdictional cooperation can produce significant highway congestion relief. But obtaining the requisite financial and political commitments to initiate corridor-wide improvements could frustrate or delay vital economic and operational benefits for the Commonwealth. While multi-state efforts provide larger overall benefit, Virginia acting alone is able to achieve measurable I-81 highway relief through investment in the parallel rail rights-of way. A public investment of $500 million in Commonwealth railroad infrastructure and rail intermodal equipment produces highway diversions between 470,000 and 500,000 annual loads over five to seven years, after construction. The Virginia-based program takes longer to mature (the initial Corridor-wide plan built up in three to five years) because its investments are lower and more restricted, and this makes their effect less strong. The results are reflected in Figure 12, and they assume Norfolk Southern will make related capital improvements outside as well as inside the Commonwealth, using other funds.

Figure 12 - Virginia-Based Investment

Projected Medium and Long-Term Diversion Impacts - NS Corridors

Medium Term Annual Impact	Annual Loads Diverted Total Corridor	Percent of VA I-81 AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario			
Low	474,000	9.8%	132.7
High	501,000	10.4%	143.5

Long Term Annual Impact	Annual Loads Diverted Total Corridor	Percent of VA I-81 Forecast AADTT Diverted	VA I-81 Truck VMT Diverted (Millions)
Public Investment Scenario			
Low	474,000	4.9%	132.7
High	501,000	5.2%	143.5

Assumptions:

1. Adequate capital financing can be procured.
2. Local resistance does not preclude growth in rail traffic.
3. An "Open" Intermodal technology will be employed in the study corridors.
4. Railroads will offer and maintain competitive service performance in the study corridors.
5. Railroads will offer compelling cost reductions (vis-à-vis highway transport) to shippers and/or carriers currently operating on the study corridors as an offset to public investment.
6. The available infrastructure can be configured to accommodate the identified traffic growth.
7. Historical patterns of intermodal market penetration are an appropriate measure of projected penetration for lanes of similar density and distance.
8. The VDOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.
9. Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.

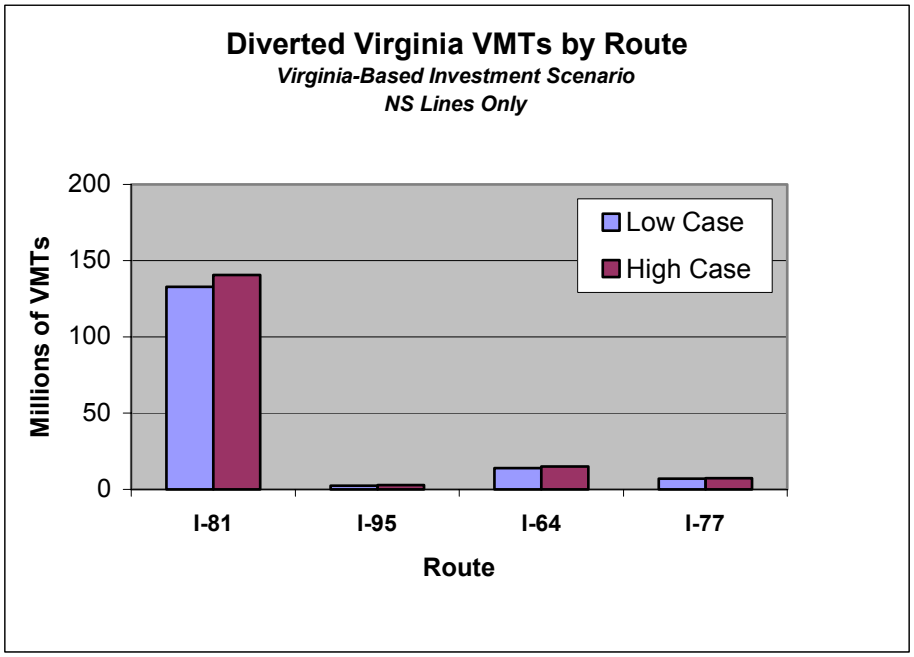
This indicates that the volume of trucks moving in Virginia on I-81 could be reduced by

9% to 10% in the medium term. (These figures are expressed in Figure 12 as percentages of Average Annual Daily Truck Traffic - AADTT). However, there are no additional, long-range diversions produced by the Virginia-based program. The reason for this is that all the capital is expended for medium-term improvements, and the Norfolk Southern system thereafter has reached capacity. More traffic cannot be absorbed without improvements in other states. Consequently, while freight traffic on the highway will continue to grow along with the economy, rail traffic cannot grow, and by the long term the effect of rail diversions will have diminished as a percent of I-81 truck volume.

The projected VMT impacts of the Virginia-Based Investment scenario are displayed in Figure 13.

Figure 13

VMT Impact of Diversions from Virginia-Based Investments in NS Lines



Assumptions:

1. Adequate capital financing can be procured.
2. Local resistance does not preclude growth in rail traffic.
3. An "Open" Intermodal technology will be employed in the study corridors.
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8. The VDOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.
9. Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.

3.5 Required Capital Investment

The remarkable success of the railroads in reducing operating costs has been met nearly dollar-for-dollar by the trucking industry. As railroads distribute capital to those projects offering the most promising financial return, the competitive marketplace in which rail intermodal operates means that investment opportunities often go wanting. In the case of the study corridors, both railroads cited capital shortages as one reason for their inability to grow North-South intermodal traffic more rapidly.

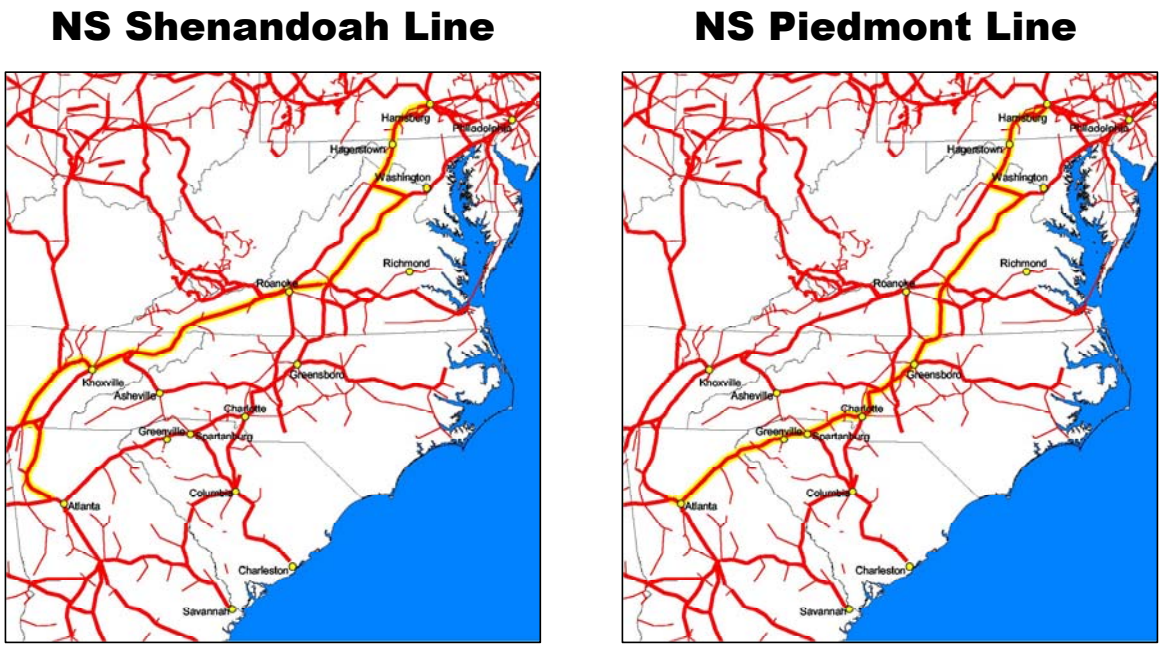
Two of NS's primary rail routes have been considered in this Study, both of which are shown in Figure 14. The first, NS's Shenandoah Route, is defined generally as being located between Harrisburg (and points north) through Hagerstown, Roanoke, and Knoxville to Atlanta, and closely parallels Interstate 81. NS's second primary route, its Piedmont Route, is located between Interstates 81 and 95, and extends generally from Harrisburg (and points north) to Hagerstown, Manassas, Greensboro, Charlotte, Spartanburg, and Greenville to Atlanta.

Capital investments that combine elements from each rail corridor are required both to improve service speed to make rail offerings competitive, and to add capacity to handle the additional rail traffic as it is diverted. To improve train speed, it is necessary to straighten out curves, improve switches and signaling, and update railroad crossings. As these investments are made, the rail service in the corridor will improve, and diversions from truck are likely. However, to handle this traffic in additional trains, capacity improvements in the form of double track installation, addition of new sidings and crossovers, and bi-directional signaling are needed.

The proposed capacity improvement projects are divided into two phases, and three categories, labeled as Column A, B and C in Figure 14 below. Included in Phase I are those projects that have the highest cost-benefit payback, and are required to support the traffic diversions projected over the three-to-five year period of the short-term diversion analysis. These projects provide much needed capacity, but are alone insufficient to accommodate the 20-year projected volumes. The improvements assigned to Phase II are designed support the full volume of traffic forecast in the 20-year diversion analyses.

For the most part the estimates rely on the information in the Norfolk Southern Timetables and the current track charts for the various districts under study. The estimates in Column A (reduced curvature to increase train speeds) are not included in Columns B and C. Column B is a *stand-alone estimate* of proposed Phase I to increase line capacity. Column C is a *stand-alone estimate* of the Phase II or the ultimate build-out to maximize line capacity for the anticipated expedited intermodal traffic. Some

Figure 14 - Primary Norfolk Southern Rail Routes



work detailed in Column C may duplicate work in Column B, but the calculated costs in Column C are made independent of the Column B estimates.

The scenarios analyzed as Phase I and Phase II are designed to reflect the most cost efficient portfolio of investments that can effectively accommodate the volume of diverted traffic identified in the short and long term scenarios. An incremental investment strategy will likely increase overall investment marginally, as work completed in one phase might require relocation or reconstruction in the next: prior to the expiration of its useful life.

All cost estimates in Columns A, B, and C include both low additives of 6% for engineering and 15% for contingencies, a total of 21%, and high additives of 32%, the latter reflecting the uncertain field conditions underlying our cost estimates. The

The scenarios analyzed are designed to reflect the most cost efficient portfolio of investments that can effectively accommodate the volume of diverted traffic identified in the short and long term scenarios.

engineering additive includes designs, specifications, permits, environmental studies and approvals, mitigation and construction management.

Column A: Estimates of cost to reduce curvature for curves that restrict train speeds below the authorized zone train speeds are included in Column A. The Norfolk Southern "Super-Elevation of Curves for Maximum Speeds" dated March 1991, prescribes the superelevation and spiral lengths for given freight and passenger train speeds which are assumed to be required for all new construction and track modifications. The maximum authorized superelevation is 4 inches for freight and 5 inches for passenger trains. The general range of curves that restrict passenger, intermodal and freight train speeds is from 4 degrees to 6 degrees. In general, these curves must be reduced to the range of 2 degrees to 3 degrees in order to conform to the Norfolk Southern Railway Company standards and provide intermodal train speeds of 60 mph. The consulting team has recommended such curve reductions where feasible on all of the NS Lines under study.

The estimates of costs in Column A for some curves include minor track shifting, increasing superelevation and lengthening spirals. Other curves located where there are a series of reverse curves with limited reversing tangents require minor to major line changes which may involve some new trackage, extensive grading and, in some cases, purchase of additional right of way.

Column B: This column can be considered as Phase I, for the capacity improvements necessary to handle a substantial increase in million-gross-tonnage (MGT) in the form of expedited intermodal rail traffic. Signal Systems were improved where necessary, new sidings were located at appropriate spacings and at locations with minimal bridge and grade separation construction. In heavier tonnage territories some sections of double track were connected where spacing is appropriate and construction costs are held to a minimum. In very heavy tonnage territory, triple track was planned.

Column C: This column can be considered as Phase II, for the capacity improvements necessary to handle double to triple the existing rail traffic on the line segment. Where the line segment currently has single track with sidings or single track between stretches of double track, the ultimate build-out becomes double track, bidirectional, Traffic Control, with universal crossovers about every

ten (10) miles. Where a current line segment has double track in heavy tonnage territory, a triple track with universal crossovers is planned.

The states included in the corridor-wide analysis represent those impacted by the current and future I-81 congestion, and/or those deriving off-corridor benefits through the conversion of highway traffic to rail intermodal. Those states include Texas, Louisiana, Mississippi, Alabama, Tennessee, Georgia, North Carolina, South Carolina, Virginia, West Virginia, Maryland, Pennsylvania, and New Jersey.

Figure 15 – Corridor Wide Investments

Estimated Right-of-Way Investment Needs for Norfolk Southern Lines by State

State	Location	Route Miles	Column A Ranges To Reduce Curvature, Increase Train Speeds (Millions)		Column B Phase I, Ranges To Increase Line Capacity (Millions)		Column C Phase II, Ranges To Increase Line Capacity (Millions)	
			Low	High	Low	High	Low	High
NJ	Manville to Phillpsburg	40.2	$ 6.9	$ 7.5	$ 29.4	$ 32.1	$ 177.4	$ 193.6
PA	Phillipsburg to Vicinity of Hagerstown MD (Mason-Dixon) via Harrisburg	172.2	$ 53.1	$ 57.9	$ 228.4	$ 249.0	$ 728.5	$ 794.7
MD	Hagerstown to Shepherd	21.4	$ 7.1	$ 7.6	$ 3.9	$ 4.2	$ 29.4	$ 32.1
WV	Shepherd to Rippon/Audley	19.3	$ -	$ -	$ 7.3	$ 7.9	$ 43.7	$ 47.7
VA	Rippon/Audley to Stokesland via Riverton Jct., Manassas and Lynchburg	282.5	$ 39.7	$ 43.3	$ 227.5	$ 248.3	$ 665.3	$ 725.7
VA	Lynchburg to Bristol including improvements to Crosstown Connection, Montview to Kinney, and Roanoke Yard Bypass Track	200.2	$ 32.7	$ 35.7	$ 132.4	$ 144.4	$ 262.9	$ 286.8
Total VA		482.7	$ 72.4	$ 79.0	$ 359.9	$ 392.7	$ 928.2	$ 1,012.5
TN	Bristol to Memphis via Knoxville, Chattanooga, Wauhatchie, CSX Joint Track to Stevenson, and line segment Wenasoga to Memphis	369.4*	$ 44.0	$ 48.0	$ 222.9	$ 243.1	$ 567.1	$ 618.7
NC	Stokesland to Grover	177.2	$ 3.1	$ 3.3	$ 53.0	$ 57.8	$ 293.7	$ 320.4
SC	Grover to Tugalo	122	$ 6.2	$ 6.8	$ 161.5	$ 176.3	$ 252.2	$ 275.0
GA	Tugalo to Tallapoosa via Howell and Austell	158.9	$ 50.0	$ 54.7	$ 153.3	$ 167.1	$ 364.0	$ 397.1
AL	Stevenson to Oldham	153.2	$ 14.3	$ 15.6	$ 121.7	$ 132.8	$ 577.1	$ 629.5
AL	Tallapoosa to Kewanee via Irondale Jct.	232.8	$ 63.9	$ 69.9	$ 93.7	$ 102.4	$ 679.4	$ 741.2
Total AL		386.0	$ 78.2	$ 85.5	$ 215.4	$ 235.2	$ 1,256.5	$ 1,370.7
MS	Oldham to Wenasoga	34	$ 8.7	$ 9.5	$ 19.2	$ 21.0	$ 108.5	$ 118.4
MS	Kewanee to Nicolson via Meridan	171.8	$ 25.4	$ 27.7	$ 142.8	$ 155.8	$ 654.1	$ 713.5
Total MS		205.8	$ 34.1	$ 37.2	$ 162.0	$ 176.8	$ 762.6	$ 831.9
LA	Nicolson to New Orleans	40.1	$ -	$ -	$ 21.5	$ 23.5	$ 82.6	$ 90.2
Total, Engineering & Contingency @ 21%		1,825.8	$ 355.1		$ 1,618.5		$ 5,485.9	
Total, Engineering & Contingency @ 32%		1,825.80		$ 387.5		$ 1,765.7		$ 5,984.6

*Includes 32.7 RM of CSX Joint Facility Track.

In addition to the line improvements detailed above, terminal expansion – estimated to total $507 million in Phase II (See Figure 16 Below) – and rolling stock acquisition – estimated to cost between $985 and $1,020 million are also required. The total of these investments is on the order of $7.9 billion over the 13 to 17 year analysis timeframe.

Figure 16

Estimated Terminal Construction and Expansion Needs by State

Terminal	State	Size	Phase I $Millions	Phase II $ Millions
Laredo	TX	Small	$21.50	$21.50
Houston	TX	Medium	18.1	35.4
Dallas	TX	Small	18.1	18.1
Subtotal	**TX**		**$57.70**	**$75.00**
Jackson	MS	Small	16.1	16.1
New Orleans	LA	Small	18.1	18.1
Atlanta	GA	Medium	21.4	41.3
Greenville	SC	Small	18.1	18.1
Charlotte	NC	Small	18.1	18.1
Greensboro	NC	Small	18.1	18.1
Subtotal	**NC**		**$36.20**	**$36.20**
Huntsville	AL	Small	16.1	16.1
Memphis	TN	Small	18.1	18.1
Knoxville	TN	Small	18.1	18.1
Subtotal	**TN**		**$36.20**	**$36.20**
Roanoke	VA	Small	18.1	18.1
Alexandria	VA	Small	21.5	21.5
Subtotal	**VA**		**$39.60**	**$39.60**
Rutherford	PA	Small	18.1	18.1
Morrisville	PA	Medium	18.1	35.4
Subtotal	**PA**		**$36.20**	**$53.50**
North Jersey	NJ	Large	42.8	$156.70
Total			**$338.50**	**$506.90**

3.5.1 Equipment Costs

The rail intermodal equipment proposed in this analysis to transport the diverse mix of highway trailers presently moving on the I-81 corridor is fully tested, and operating daily in the North American rail environment. Inasmuch as this equipment has thus far been acquired in small batches, current quoted unit costs ($60,000 per platform) do not reflect the benefits of the large productions runs that would be required to support the volumes outlined in the Study. We have therefore estimated a volume cost at a discount of 33% ($40,000 per platform) versus the current small-batch pricing. This analytical assumption was verified with former industry executives and Norfolk Southern.

The required number of platforms was calculated based on projected transit days[xii], terminal loading and unloading time, terminal idle dwell, and terminal switching times. Terminal times were adjusted based on market densities and projected market penetrations to recognize the positive impact of high-density corridor operations.

3.5.2 Volume of Trains

The impact of the diversions on the primary Norfolk Southern rail routes is such that significant capacity upgrades are required. At several points along the routes, train volumes could double or triple versus the current volumes. This increase in volume has been carefully analyzed to minimize the potential negative impacts of intensified railroad activity. A significant number of grade separations projects – to reduce highway-rail interference – have been designed into the corridor needs assessment. A table of the train volume increases resulting from the high investment case diversions is provided in Figure 17. For some areas, such volume increases may induce public outcry, particularly where the alternative truck congestion is not apparent.

Figure 17

Estimated Train Volume Increases by Route Segment -- NS Lines -- Long-Term High Public Investment Case

	Between New Orleans and Northern New Jersey			Between Memphis and Lynchburg			Other
Route Segment	Current Daily Volume Trains	Diverted Volume Trains	Total New Daily Volume Trains	Current Daily Volume Trains	Diverted Volume Trains	Total New Daily Volume Trains	Diverted Volume Trains
Laredo-Houston							6
Houston-New Orleans							20
New Orleans-Meridian	17	30	47				
Dallas-Jackson, MS							8
Jackson-Meridian							12
Meridian-Atlanta	32	42	74				
Atlanta-Greenville, SC	22	60	82				
Greenville-Charlotte	21	62	83				
Charlotte-Greensboro	36	70	106				
Greensboro-Lynchburg	31	76	107				
Memphis-Huntsville, AL				35	8	43	8
Huntsville-Chattanooga				20	14	34	
Chattanooga-Knoxville				34	14	48	
Knoxville-Roanoke				11	22	33	
Roanoke-Lynchburg				27	22	49	
Lynchburg-Manassas	17	98	115				
Manassas-Alexandria							10
Manassas-Harrisburg	22	86	108				
Harrisburg-Philadelphia							18
Harrisburg-Northern New Jersey	25	64	89				

Notes: (1) Assumes that Philadelphia traffic is routed via Harrisburg.

(2) Current train volumes based on 2001 NS Traffic Density, calculated at 3100 gross tons per train.

While the sheer magnitude of the investment and the corresponding modal shift makes the implementation of such an initiative appear daunting, the reality is that both the investment demand and the diversion results will be sequenced by the dynamics of the transportation marketplace. Modal shifts occur gradually, and some expenses can be timed to meet the rising acceptance of the new service that is likely to occur over a thirteen to seventeen-year timeframe.

3.5.2.1 Virginia Based Investments (Independent Action)

The Virginia-based investments are a smaller scale version of the larger program, meant to act either as a first step toward a corridor-wide system, or as a shorter range alternative using fewer, and Commonwealth-controlled resources. They utilize a more limited and focused terminal network, with facility expansion provided by the Commonwealth in Virginia and arranged by Norfolk Southern in other states. The public capital requirement is $500 million for a medium term horizon. It makes track improvements chiefly on the Norfolk Southern Piedmont line from Manassas to the Maryland border, reducing curvatures and revising superelevation, improving track speed, and boosting capacity with double tracks, siding extensions and bypasses. Intermodal rolling stock is supplied to run throughout the reduced network.

The Virginia-Based Investment scenario contemplates the operation of up to six pairs of trains in each direction, through Virginia. Volumes are such that approximately two-thirds of those trains would operate over Norfolk Southern's Piedmont Line, and one-third operating over the NS Shenandoah Line. The program and its primary features are set forth in Figure 18.

Figure 18 -Virginia-Based Investment

Medium Term Capital Needs Assessment - Total For NS Corridors

Medium Term Investment	Capacity and Speed Improvements	Terminal Expansion and Construction	Rolling Stock Acquisition	Total
Public Investment Scenario	(Millions)	(Millions)	(Millions)	(Millions)
Low	$242	$21	$229	$492
High	$242	$21	$238	$501

Long Term Investment	Capacity and Speed Improvements	Terminal Expansion and Construction	Rolling Stock Acquisition	Total
Public Investment Scenario	(Millions)	(Millions)	(Millions)	(Millions)
Low	N/A	N/A	N/A	N/A
High	N/A	N/A	N/A	N/A

Assumptions:

1. Limited network of terminals including Meridian, MS; Huntsville, AL; Atlanta, GA; Knoxville, TN; Alexandria, VA; Harrisburg, PA; Philadelphia, PA; and Elizabeth, NJ.
2. Additional right of way improvements in West Virginia and Maryland would be financed by Norfolk Southern (perhaps in conjunction with other public sector sources), as would terminal construction in Mississippi, Georgia, Tennessee, Pennsylvania and New Jersey. These costs are estimated to be $23 Million and $130 Million respectively.
3. Capacity limitations on NS rail network, and expected traffic growth in carload segments preclude any significant volume of diversions in excess of those stated above, more so over a longer analysis period.

4. Study Results

The customer research and detailed market analysis conducted for the Study show that an investment of between $2.6 billion and $2.8 billion produces a range of highway diversions of between 670,000 and 720,000 loads annually over a three to five year span. These diversions could reduce the volume of trucks by between thirteen and sixteen

percent over current AADTT levels. Over the longer term, an investment of between $7.3 billion and $7.9 billion can produce highway diversions of between 2.8 to 3.0 million loads annually over thirteen to seventeen years (after construction). Translated, this analysis indicates that the volume of trucks moving on I-81 could be reduced by up to 30% from currently forecasted 2020 Average Annual Daily Truck Traffic (AADTT). The highway impact of the diversions represents a reduction of between 700 and 800 million Vehicle Miles Traveled for I-81 alone. The investments required to affect such traffic diversions are historic, including up to $6 billion in track and line upgrades, $1 billion in rolling stock costs, and $500 million in terminal construction costs.

With intermodal growth forecast to grow at 5% annually over the next several years, the 2020 volumes developed in this analysis – using a superior intermodal product – appear reasonable, if not conservative.

Other analyses conducted for this study suggest that long term impacts can be enriched by 1% overall, and 5% at shorter distances, using additional incentives directed to shippers and motor carriers.

This represents material relief from the 2020 projected Average Annual Daily Truck Traffic totals forecasted for the I-81 corridor, and provides collateral benefits to several of the region's other arteries.

The opportunity to convert traffic volumes of this magnitude produces a fundamental shift in public-policy options for Federal, State and County governments. Rail investment now serves as a legitimate option for the provision of significant freight capacity in segregated rights-of-way. The results produced in this analysis while dramatic, are not unprecedented for mature intermodal lanes. The figures developed in the Study suggest that by 2020, intermodal market share would range between 28% and 30% of all trucks currently moving on the highway. As of 2002, intermodal market share in the Chicago-New York lane[xiii] is 25% of all truck movements or 37% of dry-van movements (using conventional intermodal technologies). With intermodal growth forecast to grow at 5% annually (nationally) over the next several years[xiv], the 2020 volumes developed in this analysis – using a superior intermodal product – appear reasonable, if not conservative.

The proposed investments succeed in delivering favorable results through an innovative product proposition that relies upon (1) a flexible or "open" intermodal technology, (2) a single-driver truck competitive intermodal service, and (3) a compelling economic advantage produced through public-private cost sharing.

These success factors are aided by two additional environmental factors. The first of these is the confluent volume of traffic in the region that is funneled through a limited selection of highway arteries. For I-81 through Virginia, the streams of highway volume between numerous individual city pairs converge on a portion of the interstate system, creating the necessary traffic densities for trainload transportation.

The second factor is the successful elimination of the Conrail "watershed" by Norfolk Southern and CSX Transportation providing the "missing link" in the eastern intermodal service network. With the integration of Conrail, CSX and NS have gained significant commercial and strategic advantage: the ability to provide single-carrier intermodal service between the Southeastern and Northeastern United States.

The basic strategies of implementation reflect the commercial and economic realities of the transportation marketplace, and evidence the logic and practicality of the suggested approach. First, the proposed service relies upon a direct appeal to network motor carriers. These carriers are the price and service leaders in the trucking industry, and the primary consumers of rail intermodal services. The appeal to these carriers insures faster intermodal market penetration, and better performance to shippers' logistics demands.

Second, the investments proposed in the Study represent network-level investments in the U.S. rail network. These investments include expanded line capacity, increased terminal capacity, and updated locomotives and rolling stock. The investments outlined in the Study are all proven technologies, fully tested and currently operating in the North American railroad environment. These investments produce the intermodal product performance changes required to deliver modal shifts and hence highway relief in the corridor.

The investments outlined in the Study are all proven technologies, fully tested and currently operating in the North American railroad environment.

While Virginia serves as the primary recipient of highway relief, the required investment, and the resulting benefits of the proposition reach well beyond its borders.

The addition of rail intermodal capacity in the I-81 corridor helps address the national capacity challenge; how do we to accommodate the projected traffic growth in a practical manner? And although the target of the investment is unconventional from a public policy perspective, the identified benefits and expected results are no less credible.

In addition, the investment seeks to improve the perception of safety in mixed-use rights-of-way typical of today's highway network. Reducing the number of car-truck interactions in the corridor provides a less anxious environment for passenger and freight movements, and helps prevent recoil of public opinion to needed highway investment.

Finally, the proposed investments, and the consequent intermodal product improvements, address the national strategic need for continuous improvement in logistics performance. Such an investment helps maintain the global competitiveness of U.S. industry, and provides for the efficient transportation of worldwide consumer goods to U.S. markets.

The collective impact of the proposed investments creates an atmosphere that is at-once ripe for the introduction of a flexible and competitive rail intermodal alternative, and for the aggressive involvement of the public sector in private sector transportation investment.

5. Conclusions and Recommendations

The fundamental paradigm shift that is underway in Virginia, and across the nation, is the recognition that the private railroad rights-of-way offer an effective solution to public sector congestion relief. This Study demonstrates that public investment in rail intermodal infrastructure can indeed produce material relief in highway congestion in a practical timeframe.

These results are supported by the extensive market research and detailed competitive analysis that comprise this Study. Shippers and motor carriers alike promise to embrace the introduction of an improved intermodal service in the I-81 corridor, and would reward its performance with the desired mode shifts.

To achieve the necessary performance characteristics, fundamental changes in the intermodal product proposition are required. These include:

1. The adoption of a flexible or "open" intermodal technology such as the Expressway technology to provide balance efficiency for network carrier clients,

2. The provision of single-driver truck competitive intermodal service to prevent deterioration of hard-won logistics efficiencies, and

3. The creation of compelling economic advantage through public sharing of the investment burden in what is arguably the most capital-intensive industry in the world.

- The compelling results indicate that a near-term investment of between $2.6 billion and $2.8 billion can produce highway diversions between 670,000 and 720,000 loads annually over a three to five year span, after construction. Over the longer term, investments of between $7.3 billion and $7.9 billion produce a range of highway

diversions of between 2.8 to 3.0 million loads annually over thirteen to seventeen years (after construction). These volumes represent up to 30% of the AADTT projected volume on I-81 in 2020. These are corridor-wide investments as the Legislature anticipated, requiring the cooperation of other states.

- Acting independently, Virginia still can reduce highway truck volume by 470,000 to 500,000 annual loads within five to seven years after construction, at a cost of $500 million. However, the rail system reaches capacity thereafter, and without further investments out of state, the effect of rail diversion diminishes in the longer term.

This Study supports the idea that a bold, coordinated and committed effort to promote rail intermodal can absorb much of the expected growth in freight traffic on the Commonwealth's key North-South highway arteries. The network-level investments outlined in this Study, and the cooperative effort with carriers and neighboring states that such proposals will lead to, could have national import. The cost of such an effort, while significant, may prove to be significantly less expensive than other all-highway alternatives.

While the sheer magnitude of the corridor-wide investments and the corresponding modal shifts makes the implementation of such an initiative appear daunting, the reality is that the results are achieved through a series of more moderate investments. The Virginia-based program can constitute a first step consistent with longer-term development. Changes in traffic patterns generally do not occur overnight, and thus the measured implementation of the effort is in keeping with the contemporary dynamics of the transportation marketplace.

For railroads with limited capital and prospects for growth, for states with limited options for the provision of capacity, for motor carriers seeking lower costs of effective operation, and for citizens who want peace of mind on the road, such investments begin to create a new level of possibility. It is worthwhile, and in the long run it may be necessary for Virginia to undertake the challenge of creating the financing mechanisms and the regional partnerships necessary to achieve the meaningful highway relief results developed through this Study. The market certainly is big enough, and it is apt to reward performance.

Table of Assumptions

In the course of the Diversion Analysis, Reebie Associates has made the following assumptions:

1. *Adequate capital financing can be procured, and multi-state cooperation organized as necessary.*

   Whether the Corridor-wide or Virginia-based scenario is pursued, amassing the significant public and private investment capital necessary to support the projected traffic diversions is an essential prerequisite of successful implementation.

2. *Local resistance does not preclude growth in rail traffic.*

   The reasonable environmental, economic, and social impacts among communities located along the improved rights-of-way can be satisfactorily mitigated so as to permit unencumbered diversion of highway traffic to rail intermodal throughout the duration of the study period.

3. *An "Open" Intermodal technology will be employed in the study corridors.*

   The intermodal platform employed can effectively accommodate the current mix of highway trailers, including minimally dry-van, flat, bulk and tank trailers; reinforced and non-reinforced, air-ride and spring-ride equipment.

4. *Railroads will offer and maintain competitive service performance in the study corridors.*

   In the interest of maximizing revenue and income, railroads will provide a service frequency that minimizes transit delay, and operate trains at an average speed that will provide a level of service comparable to current single-driver truck transit times on a door-to-door basis. The analysis further assumes that the railroads will provide a sustained commitment to success, and that the projected volumes are allowed to build over a 15+ year time frame. In addition, we assume that the railroads will pursue the traffic commercially and maintain competitive operational performance throughout the study period.

5. *Railroads will offer compelling cost reductions (vis-à-vis highway transport) to shippers and/or carriers currently operating on the study corridors.*

The injection of public-sector investment in rail infrastructure offsets rail capital infusion, thereby making railroads more competitive in moving freight. This cost sharing (1) lowers the capital and reinvestment burden embedded in current rail costing and hence rate levels; (2) produces railroad LTV cost savings of 20% to 25% in the Low and High scenarios respectively, a significant portion of which are passed along to area shippers. The analysis further assumes a highway – style funding model for the public investment. This presupposes that public investment will be limited to infrastructure costs, and that all non-publicly supported investments where required will be made by the railroads themselves.

6. *The available infrastructure can be configured to accommodate the identified traffic growth.*

   This includes a network of available terminals and rolling stock sized to meet projected diverted volumes. Further, we have assumed that self-contained increments of investment can be defined, and they can build on one another within a long-term design.

7. *Historical patterns of intermodal market penetration are an appropriate measure of projected penetration for lanes of similar density and distance.*

8. *The Virginia DOT-approved "No-Build" scenario for I-81 remains in place, and truck tolls are not imposed.*

   Significant expansion of highway capacity, or the imposition of truck tolls on study routes could alter the projected Study results.

9. *Proposed changes to Federal Hours of Service motor carrier regulations ultimately are implemented.*

Endnote

i The way most trucks are operated is with a single driver. The length of the work day for the single driver strongly influences how quickly standard truck shipments can be delivered, along with speed limits and some other factors. To say intermodal is competitive with single driver service means it can perform as well as the standard service offered by motor carriers.

ii Condensed from longer statements contained in the AASHTO Freight-Rail Bottom Line Report, pages 79-80, published in 2003.

iii These totals are developed using Reebie Associates Diversion Model and Transearch database. A comparison of overall volumes reveals that the Transearch data developed for this analysis captures an average of approximately 12,000 daily loaded movements on I-81 in Virginia (depending on location). The 1997 AADTT data supplied by VDOT through SJR-55 reflects an average daily truck volume of 9,444, a forecasted 2005 volume of 11,894, and a forecasted volume of 25,500 trucks in 2020 (over selected portions of the highway). The Virginia Roadside Survey of 2002 reported 10,059 trucks in both directions, and the VDOT 2002 loop counts report totals of approximately 13,197 daily trucks on I-81. Although originating from various sources, the numbers were judged in a sufficiently tight range for purposes of comparative analysis.

iv The Public Investment Scenarios reflect public sector funding of rail infrastructure improvements. These investments offset private-sector capital, and include the upgrading of right-of-way, the acquisition of more versatile intermodal equipment, and the expansion or new development of terminals. The Low and High cost sharing scenarios evaluated the impact of 20% and 25% market price savings respectively. These market price savings are assumed to be derived from the elimination of railroad-funded capital costs that are embedded in Long-Term-Variable (LTV) costs. A significant portion of the capital cost relief generated by public-sector investment is assumed to be passed through to the shipping public in the form of compelling cost reductions that in turn help drive modal conversion from highway to rail. In the Low Investment Case, railroad right-of-way and terminal expansion costs are assumed to be offset by public investment, and railroad right-of-way, terminal expansion and rolling stock costs in the High Case.

v Movements greater than 500 miles

vi Excerpted from the Federal Highway Administration's Freight Analysis Framework

vii BEA to BEA Flows, 2001 Transearch

viii Results compiled from VDOT Roadside Survey of I-81 and I-95 in August 2002

ix Information obtained from undisclosed trailer leasing agency and industry experts.

x Results compiled from VDOT Roadside Survey of I-81 and I-95 in August 2002

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xii Transit days were calculated by dividing the operating rail miles by the Norfolk Southern proposed average intermodal train speed across the relevant route network.

xiii Source: BEA-to-BEA flows as measured by Reebie Associates Transearch® database; 2001 Issue. The number has been corrected for "rebilling" of intermodal freight across the Chicago gateway.

xiv Rail intermodal transportation growth could spark expansions for bulk terminals; Modern Bulk Transporter, Oct 1, 2002; http://bulktransporter.com/ar/transportation_rail_intermodal_transportation/